INFORMATION REPORT INFORMATION REPORT [redacted]

CENTRAL INTELLIGENCE AGENCY

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AIRCRAFT

MIG-21F-13

Instruction
Pertaining to Operation
and Servicing
(Instruction No GK-021-B)
Book No 3

SECRET

Book

Aircraft

MIG-21F-13

[P 1]

Instruction

Pertaining to Operation

and Servicing

(Instruction No GK-021-B)

Book No 3

[P 2]

Aircraft MIG - 21F - 13

Instruction on

Operation and Servicing

(Instruction No GK-021B)

Book No 3

Operation of the electrical and

radio equipment, instrumentation,

and oxygen equipment

These instructions on operation and servicing consists of three books:

Book No 1 - Operation of the aircraft and power plant.

Book No 2 - Operation of the armament.

Book No 3 - Operation of the electrical and radio equipment, instrumentation and oxygen equipment.

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Фигура I. Самолет МиГ-21Ф-13 (вид сбоку).

Figure 1. THE MIG-21F-13 Aircraft (side view)

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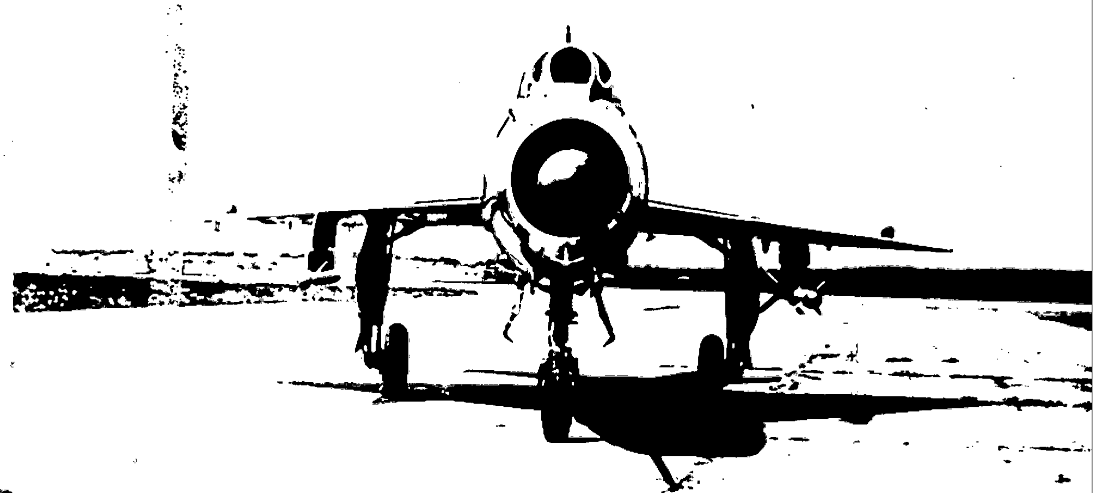

Фиг. 2. Самолет МиГ-21Ф-13 (вид спереди).

Figure 2. The MIG-21F-13 aircraft (front view).

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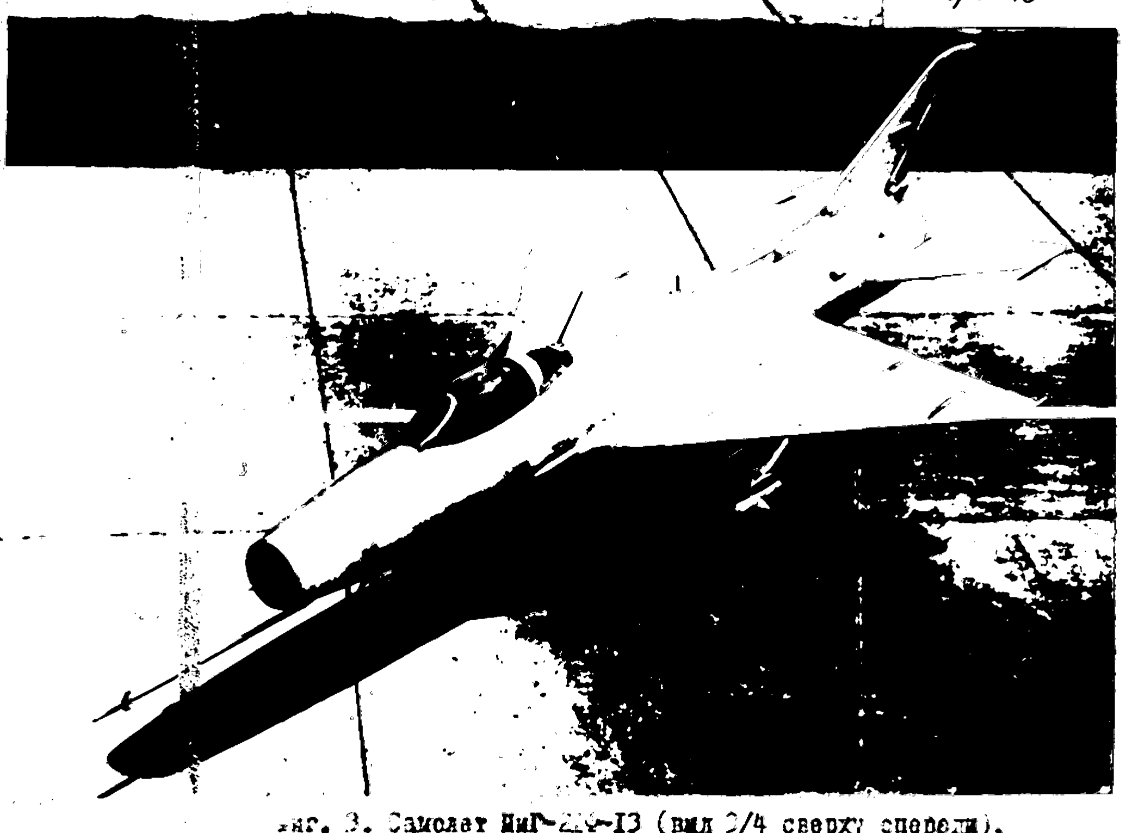

Фиг. 3. Самолет МиГ-21Ф-13 (вид 3/4 сверху спереди).
Figure 3. The MIG-21F-13 aircraft (3/4 birds-eye view, from front

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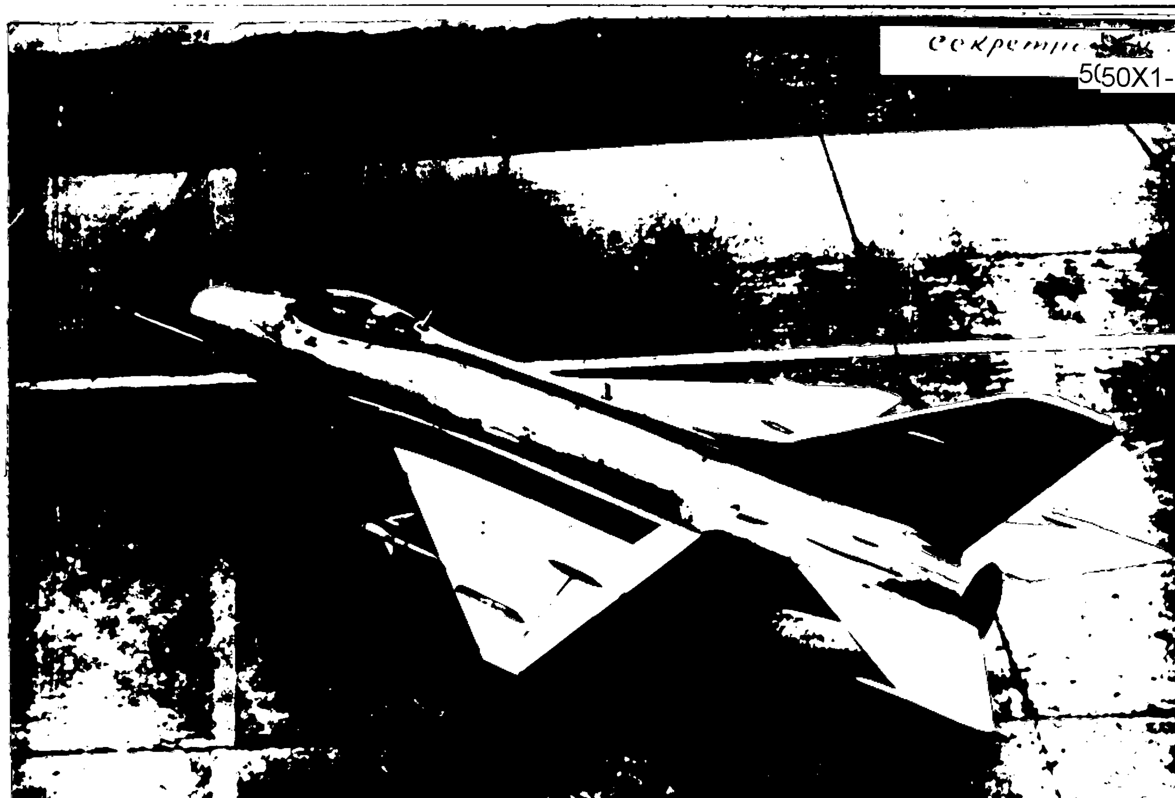

Фиг. 4. Самолет МиГ 21Ф-13 (вид 3/4 сверху сзади).

Figure 4. MIG-21F aircraft (3/4 birds-eye view, from rear)

P 8 Introduction

[P 8]

The MIG-21F-13 aircraft (figures 1-4) is a single-seater, light, day or night, fighter with high-performance flying characteristics.

The plane is designed for combat missions at high supersonic speeds and high altitudes.

It is equipped with modern electric power sources which provide the plane an ample supply of AC and DC power; with a great number of electrical devices and instruments for remote control operation of the aircraft's equipment, engine and radio devices.

The plane's radio equipment enables it to fly in daytime or nighttime; to establish contact with long-range approach-beacons; to determine when the plane is flying over long-range and short-range homing stations; to determine the altitude; to answer IFF challenges; and to determine the effective firing range. The MIG-21F-13 plane is equipped with the following radioelectronic units: RSNU-5G, ARK-10, MRP-56P, RV-UM, SRO-1 and SR.

The aircraft is also equipped with up-to-date instruments which permit flying in complicated weather conditions, to solve various problems connected with the orientation of the plane while in the air, constant and full control of the plane's flight and engine performance; and the assurance of normal operating conditions for the pilot in the cockpit. [P 9]

P 9 The compact and convenient arrangement of the flight instruments in the cockpit enables the pilot to have a clear view in all directions makes it easy for him to operate the plane in flight.

The type KKO-3 of oxygen equipment unit provides the pilot with needed oxygen when flying at high altitudes, or when cockpit pressurization fails.

The MIG-21F-13 is relatively simple to handle. It can be operated easily not only by the flying personnel, but also by the service personnel, properly instructed in the handling of supersonic jet fighter planes.

The flying and service personnel must always keep in mind that a modern fighter plane, flying at supersonic speeds, must be handled only by men who are thoroughly knowledgeable with the construction of this type of aircraft, with its instrumentation, and its electrical and radio equipment.

A good knowledge of the operational systems and good understanding of how to take care of them, as well as a sufficient knowledge of the work connected with the pre=flight preparations, will always insure trouble=free flight of the aircraft.

The MIG=21F-13 is permitted to be serviced by technicians and other maintenance personnel only after they have passed the qualification exams for their service trades.

P 10 G. General Rules [P 10]

1. The aircraft is equipped with modern, newly-designed instruments and electrical, radio and oxygen supply equipment.

To avoid accidients in flight, or during servicing and to prevent the malfunction of any of the plane's equipments it is necessary:

a) To acquire a thorough knowledge of the aircraft's design and the operating principles of its systems and units;

b) To adhere to instructions on the operation and servicing of the plane as indicated in this instruction manual;

Only those individuals who have completed special training and have acquired the necessary credits can be permitted to operate and service the units and systems of the aircraft.

2. The first part of these instructions contains regulations for getting the electrical equipment of the aircraft ready for flight, the special particulars of its operation, and routine maintenance procedures for it.

The second part of the instructions contains regulations on the aircraft's radio equipment and the routine maintenance procedures for it.

The third part of the instructions contains regulations on the [P 11] aircraft instrumentation, and the routine maintenance procedures for such.

The fourth part of the instructions contains regulations on the oxygen equipment of the plane, and the routine maintenance procedures for it.

The manual also has main feeder and wiring circuit diagrams for the aircraft equipment.

3. The operation and servicing of the various units and instruments which are provided with their own technical documents must be conducted as as specified with the documents provided with them.

4. All work on the aircraft should be made with tools and accessories which are in good condition, and which have been approved for this particular type of work. After the necessary work has been accomplished, all tools must be checked against a reference list to prevent the possibility of leaving any of them on the aircraft.

2. Precautionary measures

[P 12]

1. Before making any kind of inspection or any kind of work on the aircraft it is necessary to take all precautionary measures which have been pointed out in Book I of this instructions manual.

2. To prevent a possible discharge of the storage batteries aboard the plane, all testing of the electrical, radio or any other equipment, while on the ground, should be made only with a ground power source.

3. To insure a good start of the engine it is advisable to disconnect the ground power sources from the plane only after the engine has achieved low fuel consumption speed (r.p.m.)

4. To prevent any discharging of the storage batteries aboard the aircraft, with the exception of the fuel pump and the storage batteries, must be disconnected before stopping the engine.

After the engine switch has been shifted to the "stop" position, the fuel pump and the storage batteries must be disconnected immediately.

5. It is prohibited to permit the aircraft to be flown when the change of its storage batteries under a full load goes below 21 volts.

6. When using the self-starter, it is imperative to make sure that only equipment which is essential in getting the engine started is switched on, such as: the AZS (the automatic cut-outs), the "Starter Units", the "Radio set oil pressure gauge," Pump 2," EMF (Electromatic force) for the jettison wing tanks. Any other equipment which is not directly involved in the starting of the engine, must be switched off.

P 13 7. Before each take-off, after the engine has been started, it is [P 13] necessary for a duration of no more than one minute to switch off the generator and let the storage batteries supply the necessary current to all electrical appliances, in order to find out whether it will be charging in flight.

8. It is prohibited to clean [by conventional means] the plugs and sockets of the electrical connectors, when they become soiled, in order to prevent disruption of contact resistance in the electrical circuits. The plug and socket in such cases should be washed in pure alcohol.

9. When taking apart unmounted connectors, it is prohibited to exert force by pulling on the wire handle, to avoid possible damage to the places where the electric wires are joined to the connectors.

The separation of plug and socket must be effected by pulling directly on the two halves of the connector itself.

10. When testing the DUAS-8L and the TP-156M clocks' heating systems, it is prohibited to apply the current for more than 1 or 1.5 minutes, in order to avoid possible damage to the heating devices, because their cooling systems are not sufficiently effective on the ground.

11. Right after each flight (after the plane has landed and stopped), the pilot must disconnect all, the above-mentioned, heating devices for the same reasons, and also for preventing accidental burns to the personnel servicing the plane.

12. When testing the operation of the instruments, of the ARU-3V automatic equipment, of the clutch, the interlocking of the stick to the engine and the counterpumping valves, and also to prevent any individual instrument from getting out of order, it is necessary to build-up gradually a pressure in the PVD system for a duration of not less than 2 or 3 minutes. [P 14]

The reduction of the pressure in the PVD system must also be done gradually, and it should take not less than 2 to 3 minutes for this procedure.

13. The degree of vacuum in the static vacuum [section] of the PVD system must not exceed the equivalent of 7500 meters altitude while in the pilot system is equivalent to Mach 1.5-1.9, or else the instrument may be damaged.

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14. One must bear in mind the combination of oil and oxygen may result in an explosion. When servicing a plane one must be careful and prevent any oil or dirt from landing on the oxygen equipment.

15. Before commencing any work on the plane, the trap door which is located on the upper part of the nose section, and the circuit control switch on the dashboard should be switched over to the "disconnected" position.

16. Safety measures pertaining to the handling of radio-engineering equipment are explained in the second part of the instruction manual.

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PART ONE

ELECTRICAL EQUIPMENT

CHAPTER I

GENERAL INFORMATION ON THE ELECTRICAL EQUIPMENT

The GSR-ST-12000 VT starter generator is the main source of direct current.

Two 15STsS-45 storage batteries are reserve sources of electric power. The storage batteries are used for self-starting of the engine on the ground when there is no airfield power source.

When the generator breaks down during flight, the storage batteries are an emergency source of power. The total capacity of the storage batteries is 90 ampere-hours. This ensures flight, when the generator goes out, of at least 15 minutes. An ISA integrating meter has been installed to check the capacity of the storage batteries.

Two PO-750A converters and one PO-500A converter are the sources of alternating current with a voltage of 115 volts, 400 cycles/second. The PT-500Ts is the power source for 36 volts, 400 cycles/second.

A diagram showing location of the main units of the electrical system and the converters is shown in Fig. 3.

The GSR-ST-1200VT starter generator operates in unison with the RUG-82 voltage regulator, TS-9M stabilization transformer, VS-20 output resister for ground adjustment of the voltage, and the AZP-1MA automatic cut-out guards against overcharging.

To cut the generator into the aircraft system, a DMR-400D differential-undervoltage relay has been installed, which connects the generator to the main busbar of the power unit (aircraft main circuit), in case the generator voltage exceeds the voltage of the storage batteries. In P-19
addition to this, it:

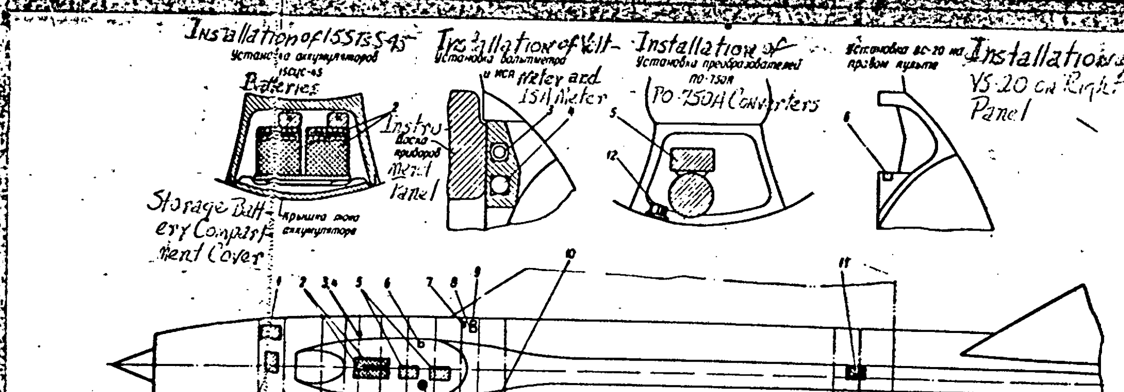

Figure 5. Diagram of the Location of the Basic Units of the Electrical System and Converters

Фиг. 5. Схема размещения основных агрегатов электросистемы и преобразователей

Fig. 5 Diagram Showing Location of the Main Units of the Electrical System and Converters. P-18

1. PO-500A Converter.
2. 15STsS-45 Storage Batteries.
3. V-1 Voltmeter.
4. ISA Ampere-Hours Integrating Meter.
5. PO-750A Converters.
6. VS-20 Output Resistor.
7. KBM-31 Capacitors.
8. DMR-400D Differential-Undervoltage Relay.
9. TS-9M Stabilization Transformer.
10. RUG-82 Voltage Regulator.
11. GSR-ST-12000VT Starter Generator.
12. Plug for Hooking-up Airfield Power Source.
13. PT-500Ts Converter

a/ cuts off the generator from the aircraft main circuit, when the generator voltage is less than the voltage in the aircraft main circuit and back current in the order of 15-45 amperes flows through the DMR-400D;

b/ prevents the generator from cutting into the aircraft main circuit when there is reverse polarity;

v/ ensures switch-on of signal "Generator Cut-out" in case there is a wire break in the section between terminals "gen" DMR-400D and "+" GSR.

The generator is hooked into the aircraft main circuit and cut out of it with a switch located on the right panel with the inscription "generator."

The RUG-82 voltage regulator is designed for maintaining constant generator voltage. Rated voltage maintained by the URG-82 regulator is 28.5 volts.

The TS-9M stabilization transformer is a current and voltage transformer. The TS-9M transformer prevents voltage fluctuation when there is a load change or change in generator rpm.

The AZP-1MA automatic circuit cut-out is designed for protecting the aircraft's direct current circuit from an accidental surge in generator voltage, caused by irregular operation of the voltage regulator and difficulties in the electrical circuit.

Aircraft electric power sources supply direct and alternating current. P-20

Equipment using direct current are:

A/ starter units and units controlling engine operation conditions;

b/ instruments indicating engine operation;

v/ fuel system units;

g/ automatic units in propulsion system;

d/ rocket and artillery armament units;

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ye/ units regulating air temperature in the cockpit;

zh/ aair gunnery sight and SIV-52 infra-red view-finder;

z/ radio and radio equipment units;

i/ fire-fighting equipment units;

k/ heating of PVD, TP-156M, timepieces;

l/ signalling and illumination equipment;

m/ flight and navigation instruments;

n/ emergency pumping station for aircraft control system;

o/ hydraulic and air system units.

The equipment using 115 volt, 400 cycles/second, alternating current are: RSIU-5G, ARK-10, RV-UM, PT-56M radios; IS-2MG system, ASP-5ND, SIV-52, MRP-56P, rockets, DIM-8T.

The equipments using 36 volt, 400 cycles/second, alternating current are the KSI, AGD-1, VRD-2A

Distribution of the equipment supplied with alternating current has been made in the following way.

The first PO-750A converter supplies power to the RSIU-5G, ARK=10, IS-2MS, PT-56M, DIM-8T.

The second PO-750A converter supplies power to the SRD, RV-UM, MRP-56P. The PO-500 A supplies power to the gunsight, SIV-52, K-13. The PT-500Ts supplies power to the AGD-1, KSI, and VRD-2A. In case the first PO-750A converter breaks down, provision has been made for emergency switchover to the second PO-750A converter. Switchover is done by turning on the auto-matic switch with the inscription "Emergency Switchover of Converters" on the right panel.

To check the generator load on the ground, an ammeter shunt has been installed in the right power unit with a plug for connecting the ammeter.

The ammeter shunt is connected in such a way that it is possible to check the load of only the generator on the ground. There is sequential interlocking to save electric power and to ensure emergency flight in case the GSR-SR-12000VT generator does not operate.

The large power consumers: sight, SRD, tank group I, RV-UM. MRP-56M, SIV-52, PO-500A, and PO-750A (2) are switched on only when the generator is operating and are automatically switched off when it does not operate or when it is switched off. The above named units are switched on when the ground power source is hooked up to the aircraft main circuit. The generator and aircraft storage batteries are automatically cut off when this takes place.

The aircraft's main busbar is powered by the GSR-ST-12000VT starter generator when the engine is operating, and by the 15STsS-45 storage batteries or ground electrical power source when the engine is not operating.

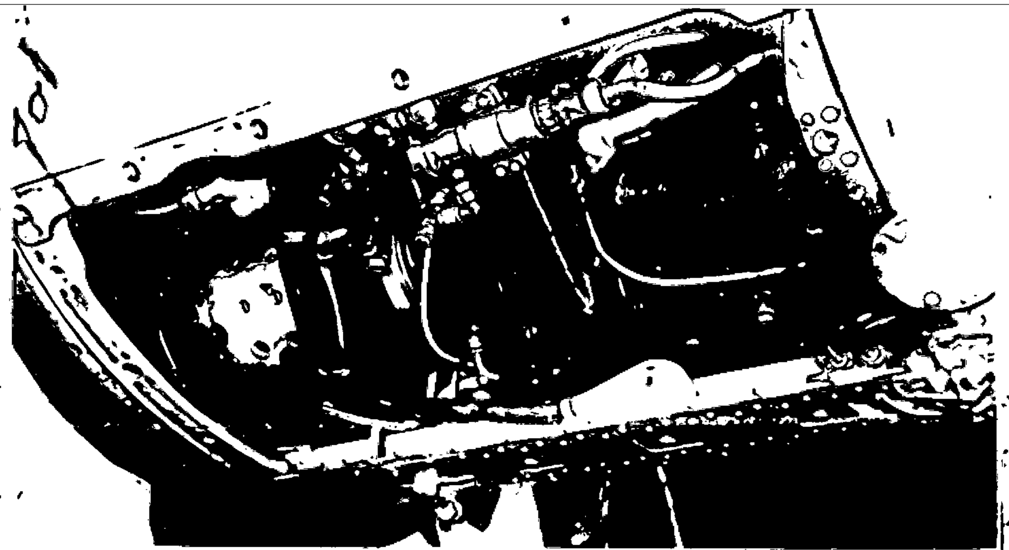
The aircraft has a single-wire circuit, i.e. only positive wires lead off the power sources to the electrical equipment, and the fuselage is

P 22 used as a negative wire.

An APA-2M ground electrical power source, equipped with a KPA-4 box hooked up to the aircraft's airfield power supply plug, is used when checking the electrical equipment and radio equipment on the ground (when the engine is not operating) and also for starting the engine.

The KPA-4 box provides hook-up of the ground electrical power source to the aircraft main circuit, and its transfer to 48 volts, and makes hook-up impossible when there is reverse polarity.

The storage batteries and generator are cut off automatically from the aircraft main circuit with hook-up of the ground electrical power source.



Фиг. 6
УСТАНОВКА ГЕНЕРАТОРА ГСР-СТ-12000ВТ
Figure 6. Installation of GSR-ST-12000VT Generator

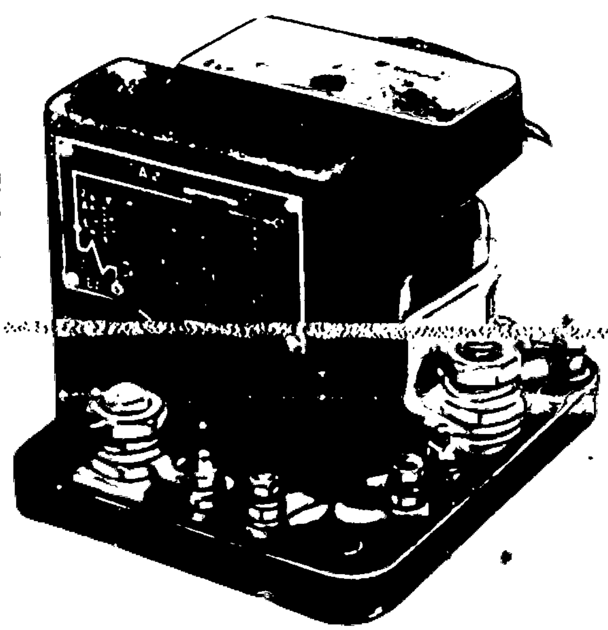


Figure 7. DMP-100 relay

Switch-on and switch-off of the ground electrical power source are done with a switch with the inscription "Aircraft Battery-Airfield" on the right panel. The storage batteries are switched on with this switch when the ground electrical power source is disconnected.

Self-starting of the engine is done from the 15STsS-45 storage batteries with switchover during starting from parallel connettion to series connection on a 24-48 volt system. For this reason, it should be remembered that when there is switchover of the storage batteries to series connection to obtain 48 volts, for 7.1 seconds after beginning of start, the aircraft main circuit with 24 volts is supplied by only storage battery No 1, which operates simultaneously at this time in its starter condition. For this reason, when self-starting is being used, make sure that only those units needed for starting the engine are switched on, i.e., "Starter Units" automatic cut out on the left panel and automatic cut out on right panel for "Radio Set, Oil Pressure Gauge," "Pump 2," EDM [electromotive force] Signal for Jettison Wing Tanks" should be switched on. All electrical equipment that does not take part in the start of the engine should be turned off. P-23

Self-starting is done in the same sequence as from the airfield power source.

After pressing the "Start" button, the engine should automatically idle smoothly without "hovering" and "popping" not more than 80 seconds.

Air by-pass valves are used and the position of the jet nozzle vanes is wide open to improve self-starting of the engine on the ground.

CHAPTER II

OPERATION OF THE ELECTRICAL EQUIPMENT

GSR-ST-12000VT Starter Generator

The starter generator operates in high temperature and high altitude conditions, and for that reason careful systematic maintenance and inspection of the generator is necessary.

The generator is instålled in the lower part of the engine between the frames No 26-28 (fig. 6).

The following must be done to remove the generator:

1. Open the "Engine Units" hatch on the right side of the fuselage in the area of frames No 27-28.

2. Unscrew the clamp and remove the air intake line.

3. Remove the drain pipe, having previously disconnected it from the hydraulic pump.

4. Open the "Engine Units" hatch on the left side of the fuselage in the area of frames No 27-28 and disconnect the power lines from the generator.

5. Unscrew the two bolts and remove the generator fastening clamp. Hold the generator when loosening the clamp. Move the generator back to take off the [word illegible] and remove the generator. Installation is done in reverse order.

Special attention should be paid to the condition of the commutator and brushes in operation. The following should be checked after every 50 hours of operation:

1. Check the condition of the brushes and commutator and measure the length of the brushes.

2. Check the condition of the bolt and screw safety wire.

3. Check the tension on the terminals of the lead wires.

4. Check how firmly the air-intake line is attached to its shield, and the shield to the generator housing. P 26

5. Check the tightness of the anchor clamp on the flange shield.

It should be remembered that in normal operation a shiny film with slight darkening (so-called "polish"), but without traces of burning and dirt, forms on the surface of the commutator.

When it becomes dirty (a greasy, dull black film), the commutator should be wiped with a clean cloth slightly dampened with clean gasoline. If the dirt does not come off, then the commutator should be cleaned with sandpaper according to instructions of the plant producing the generator.

The condition of the brushes should be watched closely. If the brushes have worn down to a length of 17 mm, then they should be replaced with new ones. The length of the brushes is measured from the longest side.

The new brushes should be installed and ground in accordance with the operating instructions of a GSR-SR-120OOVT generator. The voltage level should be regulated to the extent necessary when operating the generator. The voltage is regulated by means of a VS-20 output resistor, installed on the right panel in the cockpit.

The voltage level is not to be regulated with an RUG-82 voltage regulator by turning its core or contact screw.

The voltage should be regulated in the following way:

1. Set the head of the VS-20 output resistor in the medium position.

2. Start the engine to idle (35-40 percent) and warm up the regulator with the engine running, for not less than 5-8 minutes, with a P 27

load of 50-70 volts and storage batteries disconnected.

3. Raise the number of rpm of the engine to 73-75 percent and set the load at maximum.

4. By means of a VS-20 output resistor, regulate the voltage to 28.5 + 0.5 volts in accordance with a Class No 1 voltmeter (not lower).

NOTE: To raise the voltage, turn the VS-20 resistor head clockwise. To lower the voltage, turn the VS-20 resistor head counter-clockwise.

DMR-400D Differential Relay

The DMR-400D relay (fig. 7) is produced in such a way that when it is being used, additional regulation is not required.

The DMR-400D relay is installed between frames No ... in the port power assembly.

The following must be done to remove the DMR-400D relay:

1. Open the hatch with the inscription "Electrical Equipment" on the right side.

2. Disconnect all wires from the DMR-400D.

3. Unscrew the two screws and remove the DMR-400D.

Installation of the DMR-400D relay is done in reverse order. During installation, it is necessary to check the wires leading to the terminals of the DMR-400D and the tightness of the nuts on the terminals.

RUG-82 Voltage Regulator P-28

(fig. 8)

During prolonged operation of the RUG-82, pressure on the carbon pole decreases with wear, the regulator's operating ... shifts towards

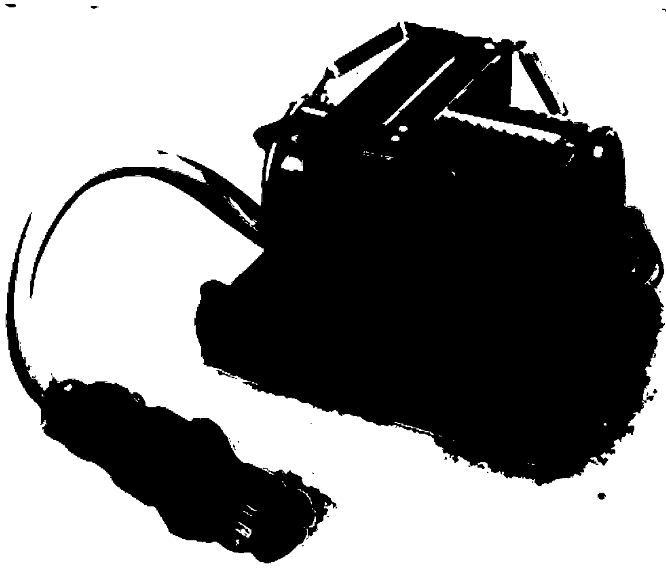


Figure 8. RUG-82 voltage regulator

Фиг. 8.
Регулятор напряжения РУГ-82

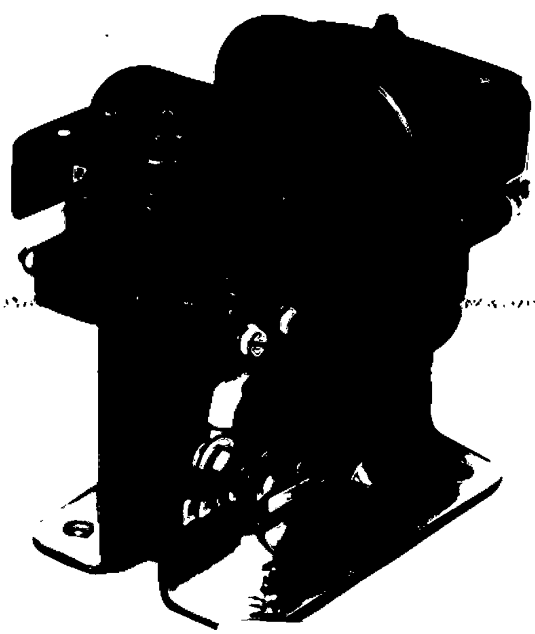


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Figure 9. TS-9M Stabilization Transformer

unstable operation and the regulator can change over to a "popping condition, which is noted during operation by oscillations of the voltage meter indicator. A "popping" condition is not allowable for operation of the regulator, because it results in disintegration and burnout of the carbon discs. For this reason, it is necessary to carefully check the operation of the RUG-82 regulator with the GSR-ST-12000VT generator

A "popping" regulator can be detected as follows:

By switching the generator into the aircraft main circuit, which operates at a high number of revolutions. When doing this, the storage batteries should be disconnected beforehand.

By switching on and dropping the load (which should not be less than 50 percent of the rated load), it is possible to detect on the voltage meter the operation of the regulator in a "popping" condition.

To check, it is advisable to switch on and off pumps I, II (supply) and III groups of tanks.

It should be remembered that the initial stage of unstable operation of the RUG-82 cannot be noticed on the voltage meter, because oscillation of the voltage meter indicator fades quickly in this instance.

Later on as wear of the carbon pole increases, the oscillations during transition conditions become more prolonged and change over to sustained "popping".

To prevent the harmful action caused by "popping", the regulator on the plane should be checked after each 50 hours of operation by a listening method. The check should be made at high number of revolutions. The check consists in listening with high-resistence earphones to the operation of the carbon pole when there is a switch-on and drop in the load. The storage batteries should be switched off from the system beforehand. P 30

The earphones are connected to the wires leading from terminals No 1 and No 6 on the female plug of the RUG-82 regulator (connection can also be made to the DMR-400D "Gen" terminal and to the TS-9M transformer "A" terminal).

During normal regulator operation, a drop in load is accompanied by a single click or several clicks (lasting not more than 1-2 seconds) and a current change in the earphones. If a scratching sound lasting more than 1-2 seconds and a wheezing sound is heard in the earphones with drops in load, this means that the regulator is not adjusted properly. Such a regulator should be taken off the aircraft for adjustment and checking.

Stable operation of the regulator is ensured by the TS-9M stabilizing transformer. Operation and checking of the regulator without the stabilizing transformer is not allowed.

The RUG-82 is installed in the area of frames Nos 12-13 in the left power unit.

The following must be done to remove the RUG-82:

1. Open the hatch on the right side in the area of frames No 15A-16.
2. Disconnect the electric plug from the RUG-82.
3. Remove the voltage regulator.

Installation of the RUG-82 is done in reverse order.

The following should be checked for, in addition to checking for "popping": P 31

1. The condition of the resistor surface.

When there are cracks and swellings on the resistor surface, the regulator must be replaced

2. The reliability of the electrical connections and the tightness of

the core adjusting screw.

3. Check how secure the panel on the aircraft is and the condition of the vibration absorbers.

4. The condition of contact surfaces and the tightness of the nuts on the terminals.

5. How secure the regulator is attached to the panel.

6. The condition of the conductors should be checked so that with shock absorption of the panel, the conductors do not wear through the vibration absorber washer and do not bend near the terminals.

TS-9M Stabilization Transformer

The stabilization transformer (fig. 9) does not require any regulation in operation. There must be good electrical contact between the transformer housing and aircraft ground. Contact resistance should not be more than 600 micro-ohms. When a defect is detected, the TS-9M has to be replaced.

The transformer is installed in the power unit in the area of frames Nos 12-13, portside.

The following must be done to remove the TS-9M transformer:

1. Open the "Electrical Equipment" hatch on the left side in the area of frames No 12-13.

2. Disconnect the wires from the TS-9M.

3. Disconnect the wires from the DMR-400D. P 32

4. Unscrew the four screws and remove the TS-9M.

When installing the transformer, the inscription "Gen" should be toward the side of the wires that lead to the generator.

KBM-31 Capacitors

Three KBM-31 capacitors are installed on the aircraft. Two [originally one] capacitors are connected to the DMR-400D and installed in the port power unit near fram No 13, and the other capacitor, in the area of frames No 15A-16, in a circuit with RUG-82.

During operation, it is necessary (especially when there is radio interference) to check periodically the contact resistance between the capacitor housing and the aircraft ground.

When there is great contact resistance, the contact between the capacitor lugs and the aircraft parts should be improved by cleaning the places where they couple.

15STsS-45 Storage Batteries P 33

Type 15STsS-45 storage batteries (fig. 10) are designed for parallel operation with the GSR-ST-12000VT generator when power is being supplied to all electric power consuming units on the aircraft, and also for supplying power to vitally necessary units during flight in case the engine stops or jams or when the generator goes out of operation.

The storage batteries also ensure self-starting of the engine.

15STsS-45 storage batteries are installed in the area of frames No 7-10 in the lower front section of the equipment.

The following must be done to remove the storage batteries:

1. Open the battery hatch in the area of frames No 7-10.
2. Disconnect the electrical plug from the batteries.
3. Disconnect the vent line.
4. Remove the retainers, take off the heating cover, and take out the storage batteries.

50X1-HUMM

-31-

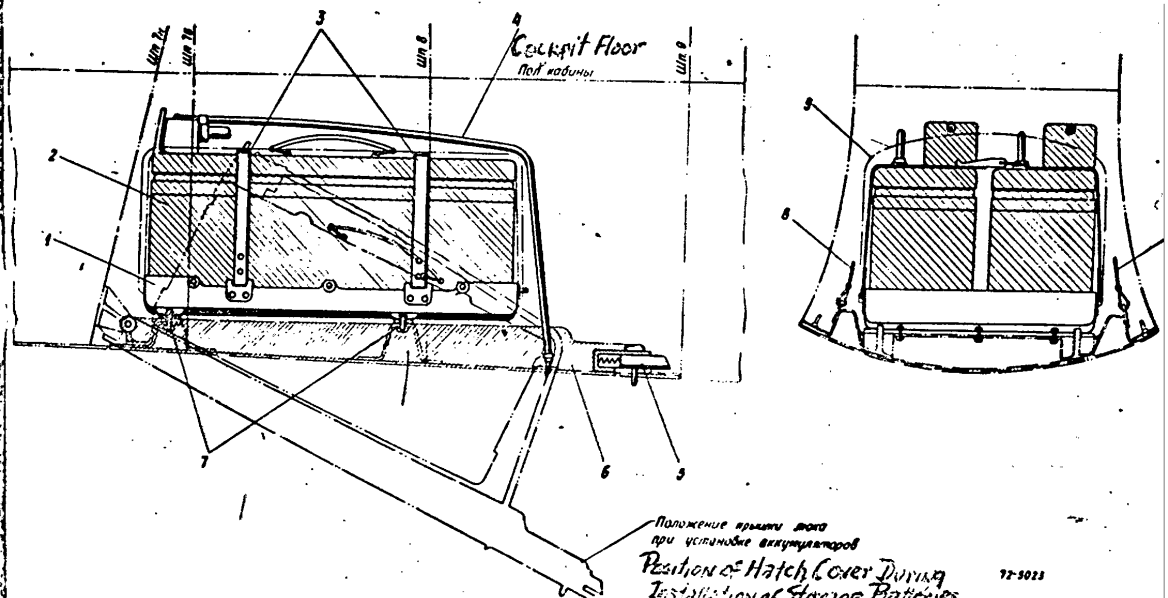

Figure 10. Installation of 15STsS-45 Storage Batteries

Фиг. 10. Установка [illegible] 15СЦС-45.

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Installation is done in reverse order.

1. Before installing fully charged storage batteries on the aircraft, set the ISA indicator at 45 ampere-hours for the rated capacity of one battery.

2. After installing the fully charged storage batteries on the aircraft, make a check for discharge-charge on an ISA meter.

When the reading on the ISA meter is higher than 45 ampere-hours, take the batteries from the aircraft and transfer them to a charging station for checking or for running a testing and aging cycle.

Fig. 10. Installation of 15STsS-45 Storage Batteries P 35

1. Case.
2. 15STsS-45 storage batteries.
3. Bands for fastening the batteries to the case.
4. Vent line.
5. Hatch cover lock.
6. Hatch cover.
7. Screws for fastening the case to the hatch cover.
8. Anchor cable.
9. Insulation.

NOTE: Because the check on the capacity is made on one storage battery, install or replace for recharging or a testing and aging cycle only in pairs. P36

3. Take batteries, having a reading of less than 30 ampere-hours on the ISA meter, and turn them over for recharging.

Recharged batteries can be installed on the aircraft without a 24 hour wait at the charging station, when the rules for checking, cited in points 9-10 (see below), are strictly observed.

NOTE: Because the aircraft system has a voltage of 28.5 + 0.5 volts, charging of batteries continues under all flight conditions. When battery discharge is detected during flight, which is determined by an ISA meter, the batteries should be taken off the aircraft after the flight, sent for charging, and the voltage of the aircraft system should be checked on the ground with generator in operation.

Make the voltage check on a class 0.5 + 1 voltage meter.

4. Self-starting is allowed not more than three times with fully charged storage batteries and not more than two times with batteries having a capacity of not less than 40 ampere-hours on an ISA meter.

5. After one month of operation or after 10 flights where self-starting has been employed, remove the batteries and send them to a charging station for running a charge and discharge testing and aging cycle and for check out.

NOTE: Storage batteries, that have undergone a testing and aging cycle, should be held for 24 hours at the charging station, and then checked in accordance with instructions of the producer plant. P 37

DO NOT: Install the batteries sooner than 24 hours after running the testing and aging cycle.

6. The batteries must be taken out of the aircraft and stored in a warm building with a temperature of not less than plus 10 degrees

centigrade and not higher than plus 35 degrees centigrade, after the completion of flights when the air temperature in the area of the airfield is lower than plus 5 degrees centigrade.

It is recommended that the batteries be installed on the aircraft 20-30 minutes prior to takeoff under these conditions. If for some reason this is impossible, then immediately after installation of the storage batteries on the aircraft when the temperature is lower than plus 5 degrees centigrade, the electric heater which is supplied with power from airfield facilities should be switched on.

It should be remembered that when the temperature of the surrounding air is lower than minus 20 degrees centigrade, the temperature of the electrolyte will fall gradually even with the heater turned on. However, high-quality operation of the batteries is ensured with an electrolyte temperature within a range of plus 5 degrees centigrade to plus 35 degrees centigrade. For this reason, it is recommended that the batteries be installed not more than 3-4 hours with a temperature of minus 20 degrees centigrade, and not more than 2 hours with a temperature of minus 30 degrees centigrade.

7. In case of breakdown or cut-off of the generator during flight, a changeover is made from the generator to the storage batteries.

Irrespective of the flight time with an inoperative generator, the storage batteries should be removed after landing and sent to the charging station for running a testing and aging cycle, a careful inspection, and the necessary check out. P 38

8. During operation all the following notes should be carefully and accurately put in the manufacturing papers of the storage batteries:

a/ number of flights with an indication of flight time;

b/ dates testing and aging cyles were made with an indication of the charge received;

v/ dates of recharge with an indication of the time and amount of recharge current;

g/ include in the storage battery manufacturing papers the capacity, which is indicated by the ISA meter, before the testing and aging cycle or recharging.

9. When receiving storage batteries from the charging station, check:

a/ EDS [EMF -- electromotive force] of each battery jar, which should be 1.82 + 1.86 volts;

b/ voltage of one battery with a load of about 100 amperes, applied in 2-3 seconds, which should not be less than 20 volts. Voltage is checked with a class 0.5 + 1 voltmeter.

NOTE: If EMF and voltage are beyond allowable limits, the batteries are not to be installed on the aircraft.

v/ cleanness of covers, valves, terminals, busbars, and inter-cell connections;

g/ tightness of all nuts; P 39

d/ conformity of notes in battery manufacturing papers with notes in log book of battery charging station.

10. After installing the two 15STsS-45 batteries on the aircract, their operation should be checked:

a/ to make sure that all units using power have been switched on in the cockpit;

b/ to make sure that the airfield power source is not hooked up to the aircraft

v/ switch on AZS [automatic cut-out] with notation "Radio Set", "Oil Pressure Gauge", "Pump 2", "Pump 3";

g/ Switch on for 2-3 seconds switch "Aircraft Battery-Airfield"

d/ check the voltage on the voltmeter, it should not be less than 21 volts;

ye/ switch off "Aircraft Battery-Airfield" and then "Radio Set", "Oil Pressure Gauge", "Pump 2", "Pump3" automatic cutout.

PUMP: If the battery voltage is less than 21 volts when the check is made, then the storage batteries must be taken off the aircraft and sent to the airfield charging station for another check and repair.

11. During operation, do not use the aircraft storage batteries for checking and adjusting electrical, radio, and instrument equipment.

In case of extreme necessity when there is no airfield power source, the storage batteries can be used on the ground, but when this is done it is necessary to watch the reading of the ISA meter carefully and the capacity of the storage battery before take-off should not be less than 30 ampere hours on the ISA meter. P 40

12. Batteries, that have reached the guaranteed service period either for calendar time or number of flight hours indicated in the log sheet, are not to be used.

13. Before each take-off and after starting the engine, it is necessary to switch off the generator for not more than one minute, transferring the power supply of the switched-on units to the storage

batteries for aging and ensuring recharging in flight.

14. Daily after completion of flights, it is recommended that the batteries be removed and sent for storage to the airfield charging station irregardless of the air temperature.

15. In case of smoke or a definite odor from under the hatch where the 15STs-45 batteries are installed, that indicates an internal-cell short circuit of the batteries, it is necessary to:

a/ switch the batteries off;

b/ open the hatch;

v/ Avoid being burned, remove the batteries, and send them to the airfield charging station.

Cell-Cell Check of 15STsS-45 Batteries

To determine the condition of 15STsS-45 storage batteries, it is necessary to make a cell-by-cell check, the purpose of which is to measure the electromotive force of each battery jar and the batteries as a whole.

To make a cell-by-cell check, there is a panel with spring contacts in the battery container cover, which ensures reliable contact with battery cell terminal.

A wire harness is attached to the battery cover and wires lead from each spring contact into the harness checking connector. P 41

When installing the batteries on the aircraft, the checking connector is fastened near the storage battery in a special hatch.

A check of electromotive force of the jars and the battery is done by means of a testing panel. The checking panel consists of a precision class No 1 voltmeter and two disc-type switches, by means of which

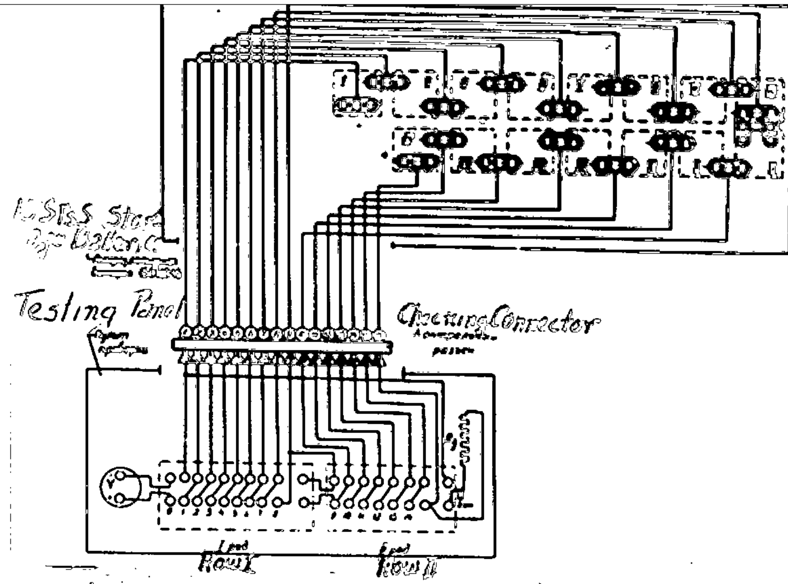

Fig. 11 Diagram of Cell-by-Cell Check of 15STsS Storage Battery

Фиг. 11. Схема поэлементного контроля аккумулятора 15СТС-45

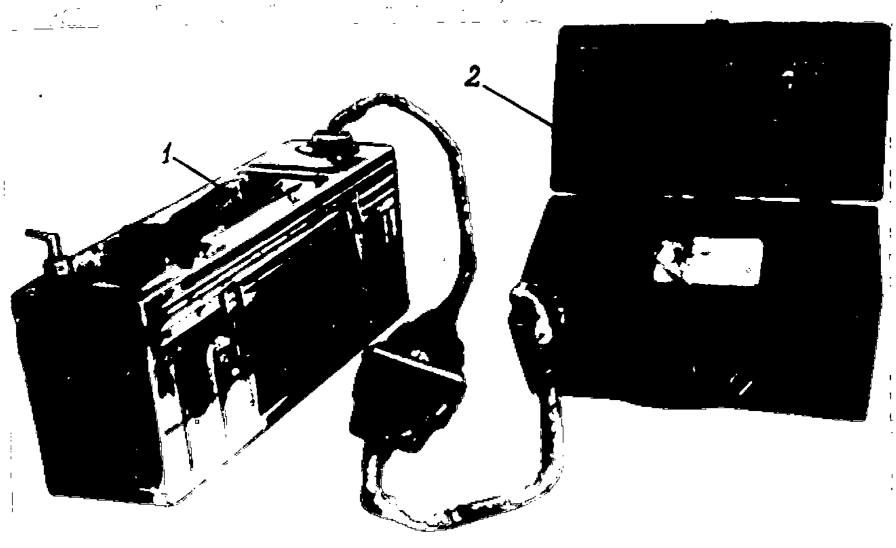

Figure 12. 1.15STsS-45 Storage Battery Testing panel

Fig. 12. Storage Battery 15STS-45

-33-

SECRET

each jar separately and the battery as a whole are connected to the voltmeter (fig. 11).

Check the condition of the batteries during pre-flight preparation of the aircraft in the following order (fig. 12)

1. Open the hatch where the battery checking connectors are located and hook up the checking panel to one of the battery connections.

2. Put the panel switch in position "O", "Row 1". With the disc-type switch in "Row I", measure the electromotive force of jar 1 to jar 8 in sequence.

3. Put the switch into position "Row II" and measure the electromotive force of jars 9 to 15 and in position "I Bat", the electromotive force of the whole battery.

4. The electromotive force of newly charged battery jars or partially discharged ones measured after being recharged should be 1.82+1.86 volts.

The electromotive force of battery jars that are partially discharged and measured prior to recharge should be 1.82+1.86 volts or 1.57+1.60 volts.

NOTE: The voltmeter graduation value when checking the electromotive force of the jars is 0.04 volts, and when checking the electromotive force of the battery, 0.4 volts.

5. Check the second battery in the same way.

6. In case the battery cells do not conform to No 4, the batteries cannot be used on the aircraft and are sent for recharging. P 43

Storage Battery Heating

Heating of the storage batteries on the aircraft is done from a ground source by means of a hot plate that has an electrical element with a thermorelay.

The thermorelay is set to open the contacts at 15 degrees, plus or minus 2 degrees, centigrade and an appropriate notation has been made in the relay's manufacturing papers. In case the hot plate with the heating element is replaced, the newly installed thermorelay should be set to open the contacts at a temperature of 15 degrees, plus or minus 2 degrees, centigrade.

The storage battery heating switch is installed in the cockpit on the right panel with the notation "Ground Storage Battery Heating". There is no heating of the storage batteries from the aircraft system.

The following must be done to check the electrical circuits for heating the storage batteries:

a/ connect the airfield power source;

b/ switch on the storage battery heating switch on the right panel;

v/ with your hand, see how the hot plate is warming up, having removed the storage batteries beforehand, and after this turn off storage battery heating switch.

NOTE: The electrical circuits for heating the storage batteries operate only when the temperature of the surrounding air is less than 15 degrees plus or minus 2 degrees centigrade and only from an airfield power source.

When the temperature of the surrounding air is more than 15 degrees, plus or minus 2 degrees, centigrade, the electrical circuits must be checked in the following way:

a/ turn off the storage battery heating switch 87K on the right panel; P 44

b/ disconnect the plug from the storage battery heating cover;

v/ with a wire, close terminals 2-3 of the wire harness connector for heating the storage battery;

g/ switch on the storage battery heating switch and check for 24 volts at terminal No 4;

d/ switch off the storage battery heating switch and recouple the connector.

ISA Integrating Meter (Fig 13 and 14)

The ISA meter is designed for checking capacity changes in the storage batteries.

The pointer on the ISA meter is set to the initial capacitance value of one storage battery. It is always possible to determine visually on the meter the capacity value of the storage batteries, because it meters expended and stored capacity.

When installing newly charged storage batteries, set the ISA needle to the number of charged ampere hours with the set screw. When this is done, the meter reading should correspond exactly to the initial capacity of the battery. Movement of the meter needle with the set screw is prohibited prior to replacement of the storage batteries.

Check the error of meter readings after every 50 hours during operation.

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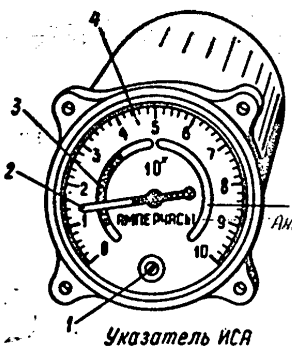
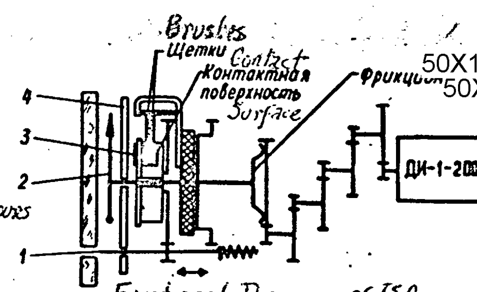
Figure 13.
Ampere-hours integrating meter
1. Set Screw
2. Needle
3. Signal dial moveable index
4. Dial
5. Opening in dial



Указатель ИСА
ISA Indicator



Functional Diagram of ISA
Кинематическая схема ИСА
Фиг. 14.
FIG. 14.

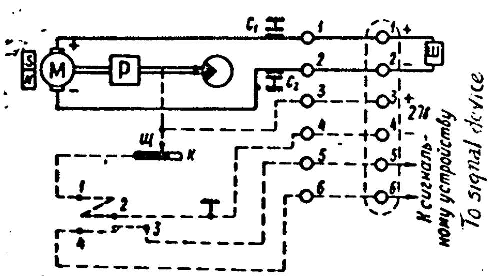


Fig 13 Electrical Circuit of Meter
Фиг. 13. Электросхема счетчика

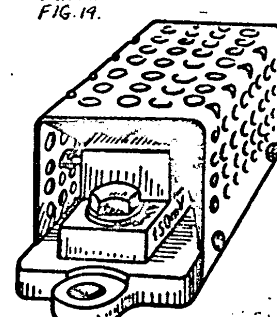


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Fig 13 and Fig 14
Фиг. 13 и Фиг. 14.

Fig. 15. Connection of Ground Power Source

Check of Disconnection of Storage Batteries When There is Hookup to Ground Power Source

1. Make sure that the voltmeter on the instrument panel gives a zero reading when there is no current in the aircraft electric system.

2. Switch on the "aircraft battery-airfield" switch on the right panel. Switch on "Pump 2" automatic cut out on the left panel and make a reading of the voltage on the voltmeter. The voltage should not be less than 24 volts.

3. Switch on "SRD", "Sight Heating", "MRP", "RV-U", "SIV-52, "Pump 1" automatic cut-out. The electrical equipment listed above should not be switched on. The airfield power source should be turned off.

4. Connect the ground power supply source when the storage batteries have been switched on. The storage batteries should be disconnected from the aircraft system, and when this is done the voltmeter should show a voltage on the airfield power source of /28-29 volts/.

5. Disconnect the ground power source.

Connection of Ground Power Source

When the DC ground power source /fig 15/ is connected with the APA-2M, the following must be done to prevent burning of the aircraft ShRA-250MLK connector terminals:

1. When connecting the socket, close the connector retainer [open when disconnecting].

2. Separate the connector only when there is no current in the connector and before separation the generator and storage battery should be switched off to the APA-2M.

3. Carefully check for cleanliness of the surfaces and for extrusion of the ShRA-250MLK socket seats. Do not let scorched and damaged seats be used. When there is evidence of scorching, wash the places making contact with alcohol. P-48

4. Do not remove the scorching from the APA-2M two-pin plug with a screw driver or file, because the pin diameter decreases and this results in an increase in contact resistance, overheating, and contact capping.

AC Power Sources

The main AC power sources on the aircraft with a voltage 115 volts, 400 cycles per second, are the two PO-750 A converters and one PO-500A converter, and with a voltage of 36 [?] volts, 400 cycles per second, a PT-500Ts converter.

To ensure 27 volts of direct current and 115 volts, 400 cycles per second, of alternating current to the checking and measuring equipment, there are plug connectors on the aircraft, which are located in the upper forward equipment section between frames No 5 and 6 on the right.

The plug connectors have the following inscriptions:

-R82 - "Power Supply of Checking and Measuring Equipment. KIA=27 volts" "kl.1+", "kl.2-"

-R86 - "Check: 1-3 kl. PO-750A (IR);

2-3 lk. PO-570A (2R);

4-3 lk. PO-500A"

"KIA Power Supply"

Connection of the check and measuring equipment (KIA) power supply is done through the "KIA" panel. Switch on the "KIA" through a special small switchboard which is attached to the aircraft.

The following must be done to ensure the checking and measuring with a power supply: P-49

1. Connect "KIA" panel to the DC 27 volt aircraft electrical system with the R82 plug connector, and to the AC 115 volt 400 cycle-per-second electrical system with the R86 plug connector.

2. Connect the AC airfield power source to the aircraft electrical system.

3. Switch on the "Aircraft Battery-Airfield" switch.

4. To get alternating current in the electridal system, start the PO-750A (IR) converter, which on the aircraft is hooked up to the circuit that ensures, when switched on, the start of any electrical equipment that is fed from this converter.

PO-750A and PO-500A Converters

Two PO-750A converters are installed in the storage battery section and one PO-500A converter in the upper radio equipment compartment.

Attention must be paid to the following things when inspecting the converters after every 50 hours of flight time:

1. The surface condition of the commutator and contact, which should be clean, and there should be no dirt and scorching on the commutator segments and contact rings. When doing this, it is necessary to distinguish between scorching and the dark colored "polish",

which forms on the commutator and contact rings, but does not affect operation and does not have to be cleaned off.

2. The condition of the brushes, which should be well ground to the commutator or to the contact rings, and easy to move in the brush holders without any sticking. P-50

3. Periodically it is necessary to blow off brush dust from the converter and measure the length of the brushes. When necessary, clean and wipe the commutator and contact rings, and clean the spaces between the bars. The commutator and contact rings should be clean without any dirt and scorching.

4. The brushes are considered to be worn out if the length on the direct current side has decreased to 16 mm, and on the alternating current side to 9 mm. If during operation, the output voltage drops from tolerance limits or is unstable, then the converter should be removed and sent for repair. Before installing the converter, press the centrifugal switch reset button as far as it will go to make sure that the converter is ready for operation.

PT-500Ts Converter

The PT-500Ts converter serves to convert 27 volt direct current into 36 volt, 400 cycles per second, three-phase alternating current and is designed for supplying the KSI course indicator system, AGD-1 attitude indicator, and VRD-2A unit. The PT-500Ts is installed in the lower forward equipment section between frames No 4-5.

Inspect and check systematically the PT-500Ts converter during use to ensure normal and reliable operation.

The 50 hour check out on the aircraft electrical goes into:

1/ How secure the converter is fastened. P-51

2. How secure the wires and plug connector are connected.

3. Check the condition of the commutator, contact rings, and brush unit, in accordance with the description of the PT-500Ts.

4. Check the voltage and frequency with and without a load.

When inspecting the commutator and contact rings, it is necessary to pay attention to the condition of their contact surfaces. During normal operation, a shiny film with slight darkening forms on the surfaces of the commutator and contact rings, but with no trace of scorching and dirt. When there is dirt (a dull, oily, black film), the commutator or contact rings should be wiped with a clean cotton cloth, dampened in gasoline.

If the dirt does not come off, then the commutator or contact rings should be cleaned with No 180-200 fine grained sandpaper. Emery paper is not to be used in this case.

The following must be done when inspecting the brushes:

1. Check their exterior for faults and make sure that there are no splits.

2. Measure the length of the brushes. If the brushes have worn down to the minimum length, then they should be replaced with new ones. The new brushes should be ground.

3. The pressure of the springs on brushes.

4. How the brush surfaces touch the commutator segments.

Checking of PO-750A and PO-500A Converter Starter Circuits and Emergency Switching

1. Connect the ground electric power source.

2. Switch on the "Aircraft Battery-Airfield" switch on the right panel.

3. Switch on the ARK" automatic cut out on the right panel and put mode switch on the ARK control panel in the first position-the PO-750 (1) should start.

4. Switch on the "Radio Set, Oil Pressure Gauge" automatic cut out on the right panel - the PO-750A (1) should start. Switch off the "Radio Set, Oil Pressure Gauge" automatic cut out.

5. Switch on the "Marker, RVU" automatic cut out on the right panel - the PO-750A (2) converter should start. Switch off the "Marker, RVU" automatic cut out.

6. Switch on the "SRD" automatic cut out on the right panel - the PO-750A (2) converter should start. Switch off the "SRD" automatic cut out.

7. Switch on the "SIV-52 automatic cut out on the right panel - the PO-500A converter should start. Switch off the "SIV-52" automatic cut out.

8. Switch on the "Sight, Sight Heating" automatic cut out on the right panel - the PO-500A converter should start.

9. Switch on the "Radio Set, Oil Pressure Gauge" automatic cut out on the right panel.

10. Switch on the "Emergency Converter Switch" on the right panel - when this is done the PO-750A (1) converter supplying power to the

following sets: RSIU-5G, ARK-10, IS-2M, PT-56M, DIM-8T, should cut off and the PO-750A (2) converter should cut in. Check the start of converters by ear.

NOTE: The type PO-750A (1) converter is started by switching on any of the electrical equipment supplied by power from this converter, except the DIM,PT-56P, and IS-2MS, which are powered by switching on any of the electrical equipment on alternating current. P-53

Check of Electrical Circuits for Starting PT-500Ts

a/ Switch on the "AGD" automatic cut out on the right panel, and when this is done, the PT-500Ts is put into operation.

Switch off the "AGD" automatic cut out.

b/ switch on the "KSI" automatic cut out on the right panel, and when this is done the PT-500Ts goes into operation.

Switch off the "KSI" automatic cut out.

Check of Electrical Circuits for Warming Up the PVD and TP-156M

a/ Switch on automatic cut out PVD, timepieces, "Emergency PVD" on the instrument panel.

b/ With your hand, check warm up of PVD, timepieces, and TP-156M, and in 1-2 minutes the PVD (DUAS receiver), TP-156M, and timepieces should be warm.

NOTE: Keep the automatic cut outs of, PVD, timepieces, and "Emergency PVD" switched on not more than one-two minutes.

Check of Electrical Circuits for Heating the Pressurized Helmet

a// Switch on "UFO" automatic cut out portable lamp, KKO-3 heating, SIGN. and AGD.

b/ With your hand, check warming of pressurized helmet face-plate, regulating the extent of warming with the RKO-45 potentiometer on the left panel. / Set it in suitable position with potentiometer knob depending on the temperature of the surrounding air.

v/ check rapid heating of pressurized helmet, having pushed "Rapid Pressurized Helmet"Heating" button on the left panel.

Illumination Equipment

To make flights at night and when there is poor visibility, and also to light up the runway when landing and taxiing, the following lighting and signalling equipment has been installed:

1. MPRF-1A landing and taxiing lights.
2. BANO-45 navigational lights
3. KLSRK-45 cockpit light.
4. Two Ufo lights in ARUFOSh-45 fixture with RUFO rheostat.
5. Landing gear signal lights and others.
6. Tail light in KhS-39 fixture.

Small MPRF-1A Landing and Taxiing Light

The small MPRF-1A landing and taxiing light is designed for lighting the runway when landing and taxiing the aircraft.

Two lights have been installed on the aircraft - on the left and right wings.

The MPRF-1A light has a high and low beam. The low beam serves to light up the runway when taxiing the aircraft, and the high beam when landing the aircraft. P-55

A light is installed on the left wing, and is set to an angle of 88 degrees. A diagram of the light angle is shown in Fig. 16a. A light is installed on the right wing and is set to an angle of 50 degrees. A diagram of the light angle is shown in fig. 16b.

Check of MPRF-1A and ANO Light Circuits

1. Switch on "Lights, Exterior Landing Gear Signal" automatic cut out.

2. Put the switch controlling the lights on the upper left electrical board of the instrument panel in the "Land" position, and when this is done the MPRF-1A lights on the left and right wings should come on high beam.

3. Put the switch controlling the lights in "Retract" position and when this is done the lights on the left and right wings should retract and go out.

4. Put the switch controlling the lights in the "Taxi" position, and when this is done the lights on the left and right wings should come on low beam.

5. Put the switch controlling the lights in the "Retract" position, and when this is done the lights on the left and right wings should retract and go out.

6. Switch off "Lights, Exterior Landing Gear Signal" automatic cut out.

7. Check operation of ANO lights: switch on automatic cut out on

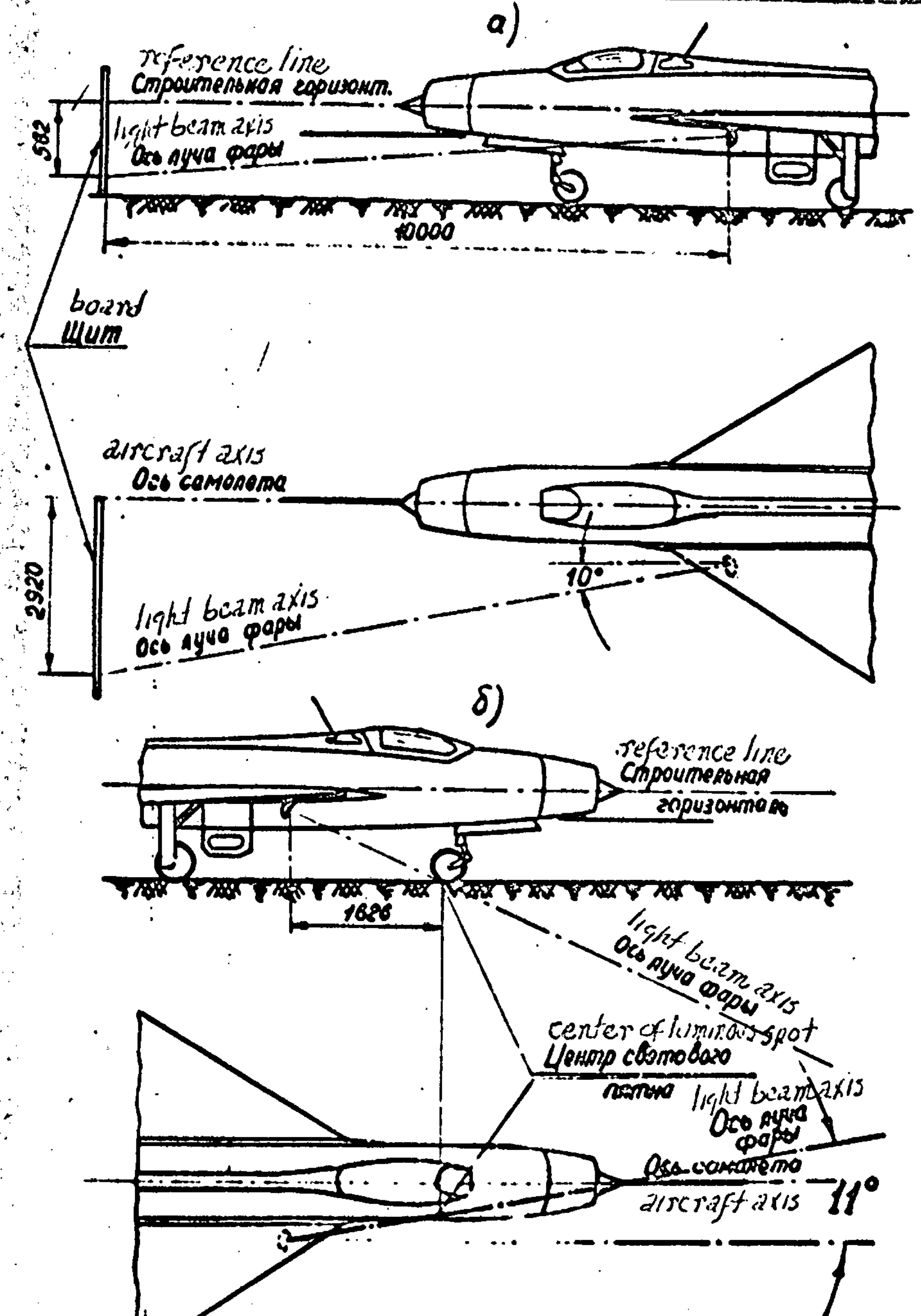


Fig. 16. Diagram of Light Adjustment

right panel of rear electrical board with inscription "ANO Landing Gear Signal" and put the ANO switch on left panel in "Full", "Medium", and "Low" positions for BANO-45 navigational lights on the right wing; BANO-45 navigational lights on the left wing and KhS-39 tail light should burn depending on the position of the switch. P-57

When checking the operation of the BANO lights during pre-flight preparation, do not let them get too hot, otherwise the glass will crack when precipitation or moisture falls on the glass.

In this regard, to pretect the bulbs, do not keep the three-position switch on more than 1-1.5 minutes.

Check of ARUFOSh-45 and Portable Lamp

1. Switch on automatic cut out of "UFA, portable lamp, KKO heating, and AGD lights" on right panel.

2. Check luminescence of USO bulbs in ARUFOSh-45 fixture from RUFO-45 rheostat.

3. Check for voltage at portable lamp plug.

4. Switch off automatic cut out of "UFO, portable lamp, KKO-3 heating, AGD lights."

Check of Landing Gear Control and Signalling Circuits

Check the landing gear control and signalling circuits when there is no pressure in the hydraulic system.

1. Switch on "ANO Landing Gear Signal" automatic cut out on right panel. Put landing gear valve in "Retract" position - hydroelectric valve should be inoperative (determine this by listening).

Make a similar check, having put the valve in the "Lowered" position.

Press on VK of retracted landing gears, located in the wheel wells, into "Retract" position, and three red lights indicating retracted landing gears light up on PPS-2 board. When landing gears are lowered, three green lights indicating lowered landing gears should light up on the PPS-2 board. P-58

Check exterior lighting of main and nose landing gear struts. To do this, switch on automatic cut out switch for "Lights, Exterior Landing Gear Lighting" on the right panel and check the exterior lighting on the main and nose struts. The exterior lighting lamps will come on if the VK of "Lowered" position are closed.

Switch off the automatic cut out switches.

MU-100AP Electromechanism

The MU-100AP electromechanism is designed for controlling the SK seat and is installed on the seat.

After every 50 hours of operation the electric motor must be checked. Attention should be paid to the following when inspecting the electric motor.

a/ condition of commutator surface, which should be clean, with no dirt and scorching on the different commutator segments;

b/ condition of brushes, which should be ground to fit snugly to the commutator, and easy to move in the brush holder;

v/ position of brush springs, which should be located in pin slit and fit without jamming into brush slots, by pressing approximately in the center.

Check of Electrical Circuits of SK Seat

1. Switch on "Seat" automatic cut out on right panel.

2. Put seat controlling switch on left panel in "down" position, when this is done the MU-100AP electromechanism on the seat will go into operation and the seat begins to move down until the VK-2-141 terminal switch disengages (on right seat track), and after this the MU-100AP electromechanism should disconnect.

3. Put the seat controlling switch in the "Up" position; when this is done, the MU-100AP electromechanism switches on and the movable part of the seat begins to move up until the VK-2-141 terminal switch disengages (on right seat track), and after this the MU-100AP electromechanism disconnects.

4. Put the seat controlling switch in the neutral position and switch off the "Seat" automatic cut out.

MGP-700 and MGP-500 Electric Motors

The MGP-500 electric motor serves to put into operation the pump of tank group I, installed in area of frame No 11.

The MGP-700 electric motor serves to put into operation the pump of tank group II, installed in frame No 18.

The MGP-700 electric serves to put into operation the pump of tank group III, installed between frames No 21-22.

The F-37VT power supply filters are switched on to decrease radio interference in power circuits of MGP-700 and MGP-500 electric motors.

The following must be done when operating the MGP-500 and MGP-700 electric motors: P-60

1. Check for good ventilation in electric motor cavity.

2. Do not start the units without fluid in hydraulic cavity to avoid breakdown.

3. Make sure that the electric motor does not idle more than 15 minutes.

4. The drain and ventilation ducts, and also plug connector should be protected against gasoline, kerosene, and other fluids, and dirt falling into them.

During operation, check how well the electric wiring is connected to the pump electric motors and the condition of the commutator and brushes after every 50 hours of flight time.

Do not let fuel get into the electrical part of the motors.

When using the filters, make sure that the filter housing covers are closed tightly and that no dirt, water, or oil has fallen into the housings. This worsens insulation and results in short circuiting. Check on condition of bonding of filters. When defects are detected, the filter should be removed and replaced with another.

Check of Fuel System Electrical Circuits

1. Switch on "Pump 1" automatic cut out switch on left panel - 422A pump of tank group I should operate. When there is no pressure in the system, "Pump 1" light on the instrument panel should come on. Switch off "Pump 1" automatic cut out.

2. Switch on automatic cut out for "EDM Hydraulic Signal for Wing Supply Tanks" on the left panel - "Supply Tanks" lamp on T-6 register should come on. P-61

3. Switch on "Pump 2" automatic cut out on left panel - pump 495A of supply tank group should operate, and when a pressure of more than 0.3 kg/square cm is achieved, lamp on register T-6 should go out. Switch on "Pump 2" automatic cut out and automatic cut out for "EDM Hydraulic Signal for Wing Supply Tanks".

4. Switch on "Pump 3" automatic cut out on left panel - pump 495A pump of tank group III should operate. When there is no pressure in the system "Pump 3" lamp on instrument panel should come on. Switch off "Pump 3" automatic cut out.

5. Switch on automatic cut out for "Emergency Jettison of RS, Tank, APU, Emergency Start of SS", press on VK in pylon - "Tank Suspension Unit" should come on. Switch off automatic cut outs.

Check on Operation of T-6 and T-4 Register Control Button

Switch on automatic cut out switch for "T-4 and T-6 Control, Remaining Fuel, Trim Tab Effect Signal" on right panel.

Press control button on T-6 and T-4 - all lamps should come on. Button should move without jamming. Check operation of "Day-Night" blind. Switch off automatic cut out switch for "T-4 and T-6 Control, Remaining Fuel, and Trim Tab Effect Signal", "Aircraft Battery-Airfield" switch, and disconnect ground power supply source.

NOTE: In case of irregularities in electrical circuits, make sure there is no voltage in the terminals leading to electrical equipment and that the fuses are all right, and then make a wire check along the principal feeder circuits for the aircraft. After locating and correcting the defect, make sure that everything is all right by a second check.

Flap Control Mechanism

The MZ-1 two-button flap control mechanism is designed for controlling the flaps and is installed in the left panel.

Raising and lowering the flaps is done by pressing on the appropriate button (fig. 17).

The MZ-1 mechanism does not have a signal light. Position of the flaps is checked on the PPS-2 flight and landing signalling device. P-62

MP-100M Electromechanism

The MP-100M electromechanism is used on the aircraft for controlling the "trim tab effect" mechanism and the ARU-3V actuating mechanism.

The MP-100M electromechanism for controlling the "trim tab effect" mechanism is installed between frames No 31-32 above in the fairing fin.

The MP-100M electromechanism for controlling the APU-3V actuating mechanism is installed between frames No 28-29 above along the axis of symmetry.

The following must be checked during operation of the MP-100M electromechanism:

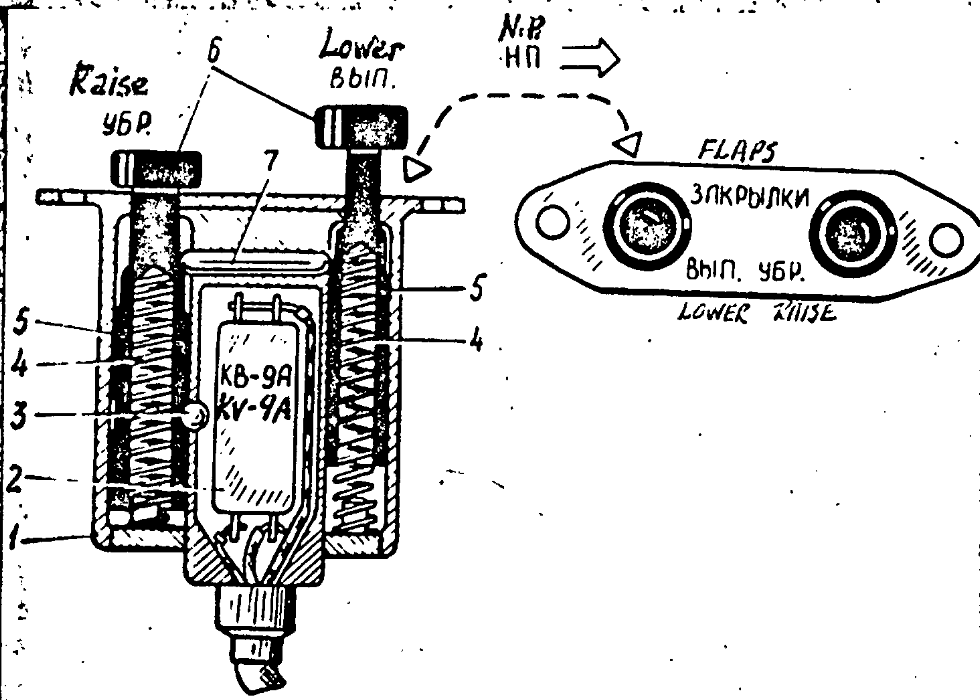
1. Reliability of contact in all places where wires with current are connected.

2. Condition of brushes.

The brushes should be installed correctly and tight against the commutator surface. In case of dirt on the brush surface, they must be again ground to fit the commutator. If the brushes are broken or worn out, they must be replaced. The brushes are considered worn out, if the length is less than 6.5 mm. Grind the brushes according to MP-100M specifications.

Фиг. 17. Механизм управления закрылками
Fig. 17. Flap Control Mechanism

1. Housing	1. – корпус; housing
2. KV-9A terminal switch	2. – концевой выключатель КВ-9А; KV-9A terminal switch
3. ball	3 – шарик ball
4. spring	4 – пружина spring
5. stem	5 – шток stem
6. button	6 – кнопка button
7. moveable catch	7 – подвижный фиксатор moveable catch



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During scheduled maintenance operations, blow out the mechanism's electric motor with clean dry air to remove brush dust. When it is being blown out, the brushes should be taken out of the brush holders. The brush springs should be without wear and corrosion.

Electromagnetic Valves B-64

The electromagnetic valves (GA-140, GA-142/1, GA-184, GA-164M/1, GA-190B, 695000/M) are designed for remote control of the hydraulic devices and pneumatic valve.

The following must be taken into account when using the valve:

1. Electromagnetic valves that do not work should be removed and sent to the producing plant.

2. Dismantling the valves under airfield conditions is strictly forbidden.

3. No provision is made for scheduled maintenance work on the valves.

[P 65]

CHAPTER III

OPERATION OF THE ELECTRICAL CIRCUIT AND ITS CHARACTERISTICS

1. General Information

All aircraft equipment, linked with the aircraft electrical circuit, is broken down into groups depending on its function.

Each group has been given a letter designation.

A table with the letters of the groups are given below.

Letter	Name of Equipment Comprising Group
E	Power supply unit, power sources
Ye	Ignition units
M	Electromechanisms and engine starter units
K	Checking Instruments
S	Signalling, Lighting
N	Navigation Equipment
R	Radio Equipment
F	Camera System
P	Armament
B	Tanks
T	Instrument Heating Units

All the instruments and units comprising one group have their own number within this group. Wires of the electrical circuit have designation strips indicating:

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a/ number of terminal it leads off of;

b/ position or plug connector the wire goes to;

v/ number of unit in group to which the wire is connected;

g/ equipment group letter designation; [P 66]

d/ wire (contact) number of unit, to which this wire is connected (plug connector, block, instrument, or other equipment).

2. Shielding of Wires

The electrical circuit of units causing interference has been shielded to decrease electrical interference in the operation of radio equipment. A poorly-shielded circuit causes more radio receiver interference than a non-shielding one, because of the additional variable contacts in the shielding system.

During operation, the condition of the ~~xxxx~~ shielded conductors should be watched so that no damage is done to the braid and that it does not become dirty. Good electrical ground of the shield with the aircraft frame is absolutely necessary for the shielded conductors. The shields should be electrically rupture-proof. Make sure that the ground clamps are tight when doing scheduled maintenance work.

3. Protective Equipment

Type SP fuses are used to protect the electrical circuit and alternating current sources when there is a short circuit. Type AZS and AZR automatic circuit protectors and Type IP and SP inertia fuses are used to protect the electrical wiring in the direct current circuit from overloads and short circuits.

The following must be done when using the AZS and AZR:

1. Do not let the contact clamps become loose during installation and dismantling.

2. Keep moisture and dust from falling on the AZS and AZR. [P 67]

3. Do not let too much force be exerted on knobs of AZS and AZR, and be careful of sharp blows.

4. At low temperatures, the start of movement of the knob should be smooth, without jerks, and further switching should be efficient and fast.

5. Opening and repair of the AZS and AZR during operation is absolutely forbidden. Uncovered AZR and AZS should not be installed on the aircraft.

6. In case of automatic switch-off of the AZS or AZR, do not switch on without determining the cause of the switch-off.

4. Control Equipment

Both direct switching equipment (switches, buttons, etc.) and remote switching equipment (relays, contactors, relay boxes) have been used on the aircraft for controlling the electrical equipment.

The switching equipment is concentrated mainly on electric panels, and relay and contactor boxes.

A diagram indicating the location of the relay, contactor, and fuse boxes and electric panels is shown in fig. 18.

[redacted]

The following is necessary during operation: [P 67] (cont)

1. Do not let the contact clamps become loose when dismantling and and installing the switches.

2. Keep moisture and dust off the switches and buttons.

3. Do not let too much force be exerted on the switches and buttons.

4. At low temperatures, the start of movement of switches should be smooth and not jerky and further movement should be fast.

5. Opening and repairing the switches and buttons are absolutely [P 70] forbidden. Opened switches and buttons should not be installed on the aircraft.

6. The 87-K switch and 88-K switch do not have special instantaneous action mechanisms, and thus they should be switched with rapid motions.

7. Make sure the adjusting screws are tight and the wires leading to the terminal switches are secure in the clamps.

8. Make sure the microswitches and terminal switches are clean. Do not let them get dirty and do not let moisture seep into the mechanism. The stem can seal up if the microswitbhes become dirty.

9. Periodically inspect the carbolite case of the microswitches.

10. Check for ease and smoothness of movement of the microswitches.

11. When inaccuracy and wear of the microswitches and terminal switches is detected, remove them from the aircraft and check them.

[redacted]

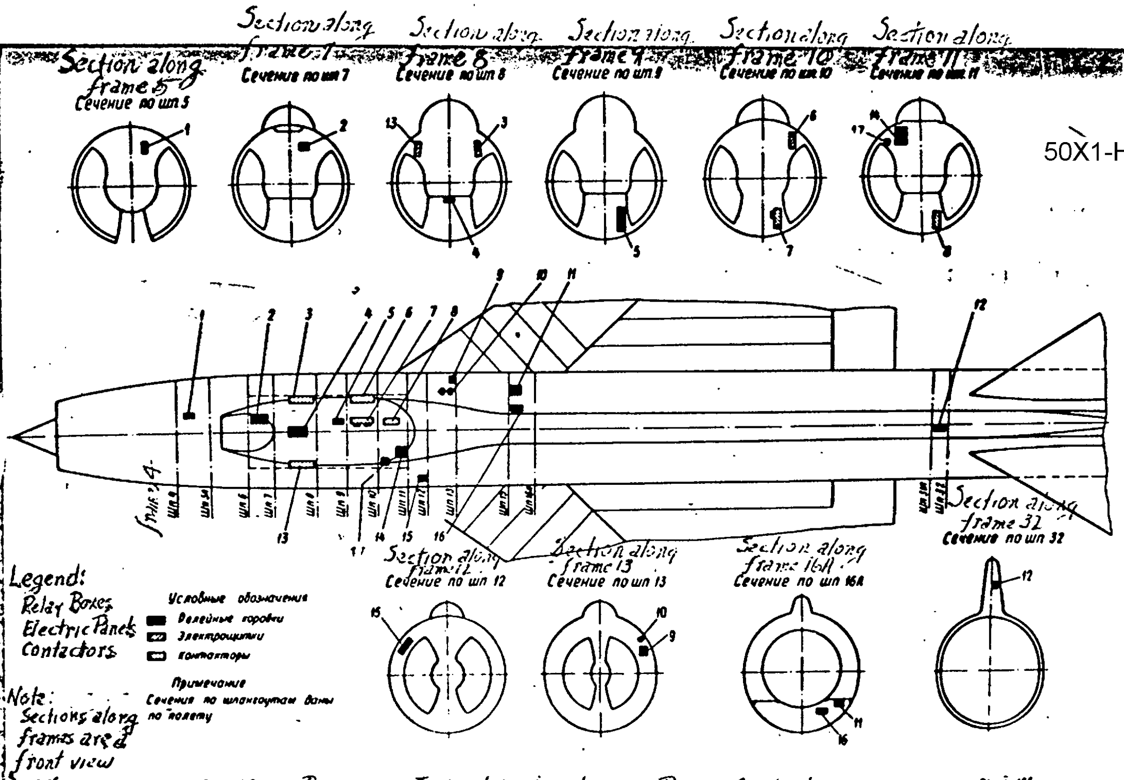


Fig. 18. Diagram Indicating Location of Relay, Contactor, Fuse Boxes and Electric Panels

Фиг. 18. Схема размещения релейных, контакторных, предохранительных коробок и электрощитков.

Fig. 18 Diagram Indicating Location of Relay, Contactor, and Fuse Boxes and Electric Panels. [P 69]

1. Box for relays and fuses of PT-500Ts.
2. Relay box near frame No 6 and behind the instrument panel.
3. Forward electric panel of right cockpit console.
4. Starter contactor and resistance box between frame No 7A-8.
5. Relay and fuse box in lower section, near frame No 9.
6. Rear electric panel of right console.
7. Contactor box.
8. Starter contactor box
9. Relay and fuse box in power unit
10. Contactor unit.
11. Relay box between frames No 15-16.
12. Relay box in tail section of fuselage.
13. Electric panel of left console
14. Relay and fuse box near frame No 11.
15. Relay box between frames No 11 and 12.
16. Relay box between frames No 15-16A.

Types KM and KP contactors and types TKE and TKD (contactor) relays are used on the aircraft for remote switching. An AV-7-44-5 automatic timing device and KPR-15A ~~starting~~ relay box are used in addition to these for automatic control of engine starting.

A KAF-13D relay box - 3 series - is used for controlling engine operation.

During operation of the contactors, carbon can form on the contacts, but [P 71] it should not be removed by cleaning or filing. Their contact resistance is an indicator of the work capacity of the contactors.

The contact resistance should be such that with rated current the voltage drop should not exceed 240 millivolts for two pairs of contacts. If the voltage drop for two pairs of contacts is more than 240 millivolts, then the contactor should be removed and replaced. Do not let liquid fall on the contactor.

During operation, it is necessary periodically to inspect how well the electric wiring is fastened to the contactor and how well the contactor is fastened to the fuselage.

Distribution of Electric Power on Aircraft

Distribution of electric power on the aircraft from the power sources to the electrical equipment is made to take account of simultaneous supply of electric power from the starter generator to the electrical equipment. The main switching and distributor devices on the aircraft are the power units (fig. 19 and 20) and panels, located on the starboard and port sides of the

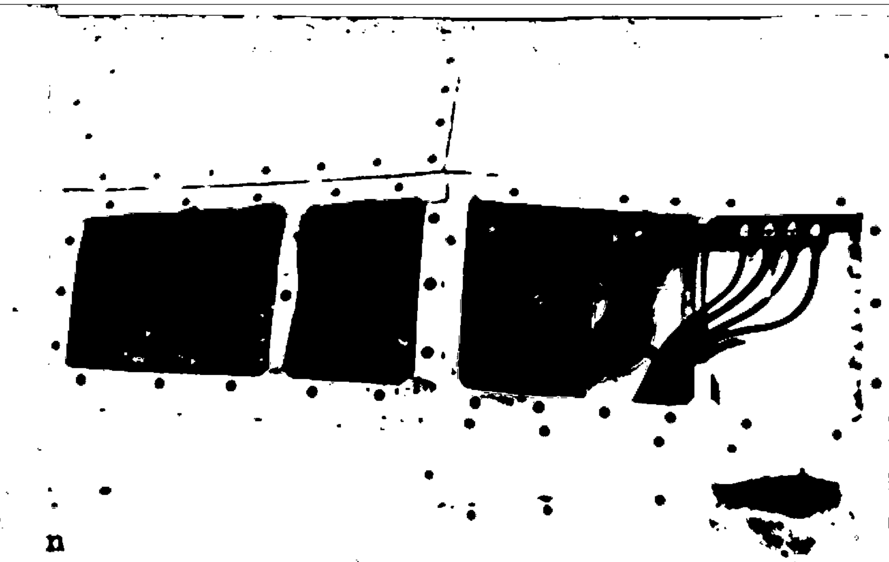


Figure 19. Starboard Power Unit

ФИГ. 19
ПРАВЫЙ ЭНЕРГОУЗЕЛ

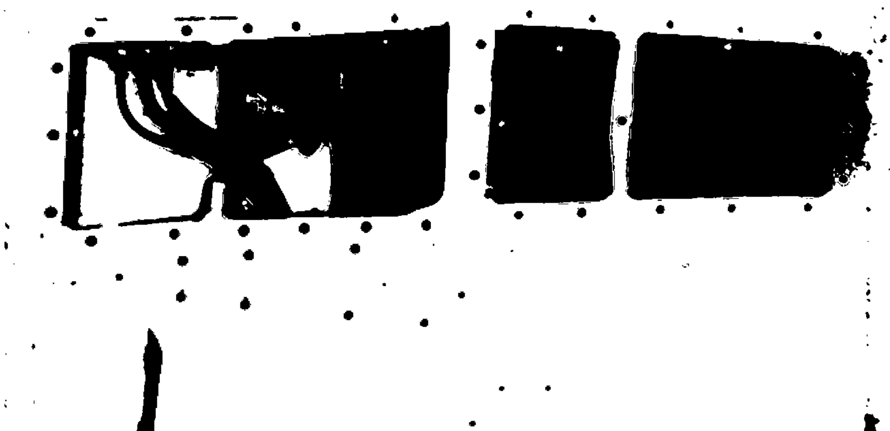
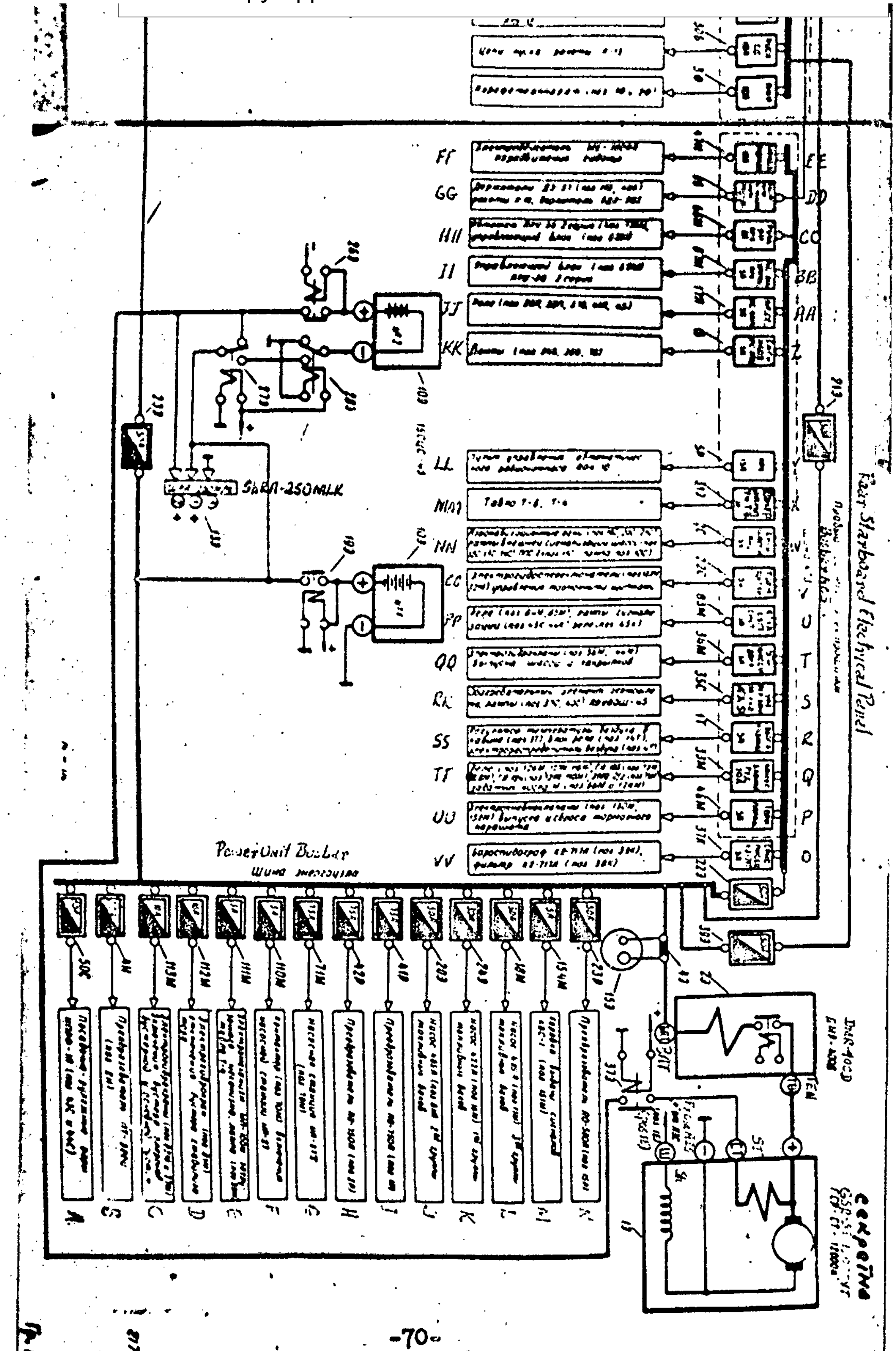


Figure 20. Port Power Unit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ShRA-250MLK
Fwd Starboard Electrical Panel
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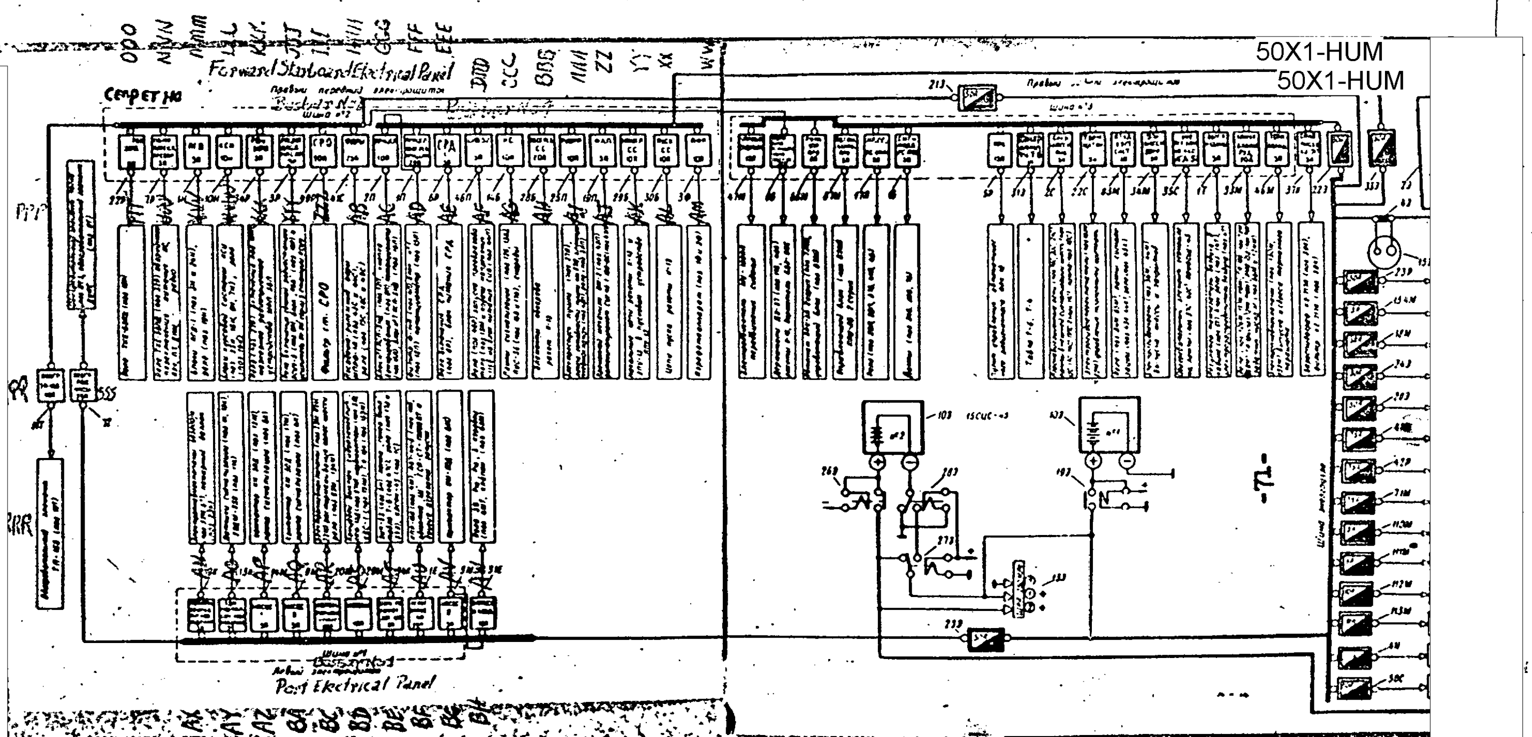

Фиг. 21. Распределение электроэнергии по потребителям.
Fig. 21. Distribution of Power to Electrical Equipment

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Fig. 21. Distribution of Power to Electrical Equipment

A. MPRF-1A Landing and Taxiing Lights (Pos. 43S and 44S)

B. PT-500Ts Converter (Pos. 2M)

C. Electrohydraulic Valves (Pos. 82M and 27M) for Switching-on Aileron Servo-Motor of Servo-Motor and Main Systems

D. Electrohydraulic Valve (Pos. 81M) for Switching-off Stabilizer Servo-Motor

E. MP-100M Electromechanism of Loading Mechanism, Lamp (Pos. 59M), T-4 Register

F. Contactor (Pos. 70M) for Switching-on NP-27 Pumping Station

G. NP-27T Pumping Station (Pos. 79M)

H. PO-750A Converter (Pos. 2R)

I. PO-750A Converter (Pos. 1R)

J. 495A Pump (Pos. 8M) of 2nd Fuel Tank Group

K. 422A Pump (Pos. 16M) of 1st Fuel Tank Group

L. 495A Pump (Pos. 11M) of 3rd Fuel Tank Group

M. KVS-1 Signal Output Box (Pos. 151M)

N. PO-500A Converter (Pos. 15R)

O. K2-747 Recorder 5A

P. Parabrake 5A

Q. RUD Clutch Cone 10A

R. Cockpit Heater 5A

S. UFB [Illegible] Lamp [Illegible] AGA-5

T. UPA Landing Gears [Illegible] 5A

U. Disconnection of Booster System 5A [?]

V. Landing Brakes 3M

W. ANO 5A Landing Gear Signalling

X. TaTb (?) central lamps

Y. ARK 15A

Z. [Illegible]

AA. [Illegible]

BB. [Illegible]

CC. [Illegible]

DD. [Illegible]

EE. [Illegible]

FF. MU-100AP Electric Motor for Moving Seat

GG. DZ-57 Locks (Pos. 11B, 405), K-13 Missiles, [type designation illegible] Pylon

HH. ARU-38 Automatic Series 2 (Pos. [Illegible]), Control Assembly (Pos. 62M)

II. Control Assembly (Pos. 62M), ARU-38 Series 2

JJ. Relays (Pos. 26P, 28P, 37B, 41P, 45)

KK. Lamps (Pos. [Illegible])

LL. ARK-10 Automatic Radio Compass Control Panel

MM. T-6, T-4 Registers

NN. Navigation Lights (Pos. 19S, 20S, 21S), Landing Gear Exterior Signalling Lights (Pos. 12S, 13S, 14S), PPS-2 (Pos. 11S), Lamp (Pos. 10S)

OO. Electrohydraulic Switches (Pos. 22M, 32M) for Controlling Landing Brakes

PP. Relays (Pos. 84M, 85M), Signalling Lamps (Pos. 43K, 44K), Relay (Pos. 45K)

QQ. Electrohydraulic Valves for Putting Landing Gears and Flaps Down (Pos. 36M, 44M)

RR. Pressurized Helmet Heating Element (Pos. 37S, 40S), ARUFOSh-45

SS. Cockpit Air Temperature Regulator (Pos. 37), Relay Assembly (Pos. 147), Electric Air Distibutor (Pos. 4T)

TT. Relays (Pos. 126M, 127M, 128M), GA-185 (Pos. 72M, 73M), GA-184 (Pos. 121M, 140M), EMO-2/2 (Pos. 75M), Mach-Meter (Pos. 66M and 124M)

UU. Electrohydraulic Valves (Pos. 130M, 132M) for Putting Out Parabrake

VV. K2-717A Barospeedograph (Pos. 39K), K2-717A Filter (Pos. 38K)

WW. AFR 10A

XX. SS Start 10A

YY. SS Incandescence 10A

ZZ. FKP 5A

AAA. Cannon 10A

BBB. SS Heating 20A

CCC. RS 10A

DDD. SNV-52 5A

EEE. SRD 5A

FFF. Sight Heating 20A

GGG. Sight 10A

HHH. Lights 25A

III. SRO 10A

JJJ. [Illegible]

KKK. RVU-IRP 5A

LLL. KSI 10M

MMM. AGD 5A

NNN. [Illegible]

OOO. RVU IRP 5A

PPP. Timepiece Heating Element (Pos. [Illegible]), DUPS Heating Element (Pos. [Illegible])

QQQ. [Illegible]

RRR. TP 156 Heating Element (Pos. 10T)

SSS. [Illegible]

TTT. TKE-53PD (Pos. [Illegible])

UUU. TKE-56PD Relay (Pos 32R) for [Illegible] Switching of Power to IS, ARK, PT, DIM, Radio

VVV. AGD-1 Units (Pos. 3N and 24N), Relay (Pos. 19N)

WWW. KSI Direction System Units (Pos. 25M, 18M, 9M, 7M), Relay (Pos. 10M)

XXX. Relay (Pos. 27R) for Switching On RVU-IRP, MRP-56P Marker Beacon Radio

YYY. Relay for Switching On RSIU-5 (Pos. 8R) Coomunications Radio, R58 Unit (Pos. 10R), and UK-2M Amplifier [Illegible] RSIU Radio

ZZZ. Filter from SRO

AB. MPRF-1A Landing and Taxiing Lights (Pos. 43S and 44S), Relay (Pos. 13S, 48S and 49S)

AC. ASP-5ND Unit No 1 (Pos. 12P), [Illegible] Button (Pos. 8P), Potentiometer (Pos. 15P), ASP-5ND Unit No 7 (Pos. 16P)

AD. F-14A Filter (Pos. 4P), Unit No 1 (Pos. 12P), Potentiometer (Pos. 15P)

AE. SRD Relay Switch (Pos. 8R), SRD Power Unit

AF. Relay (Pos. 46R) for Starting Converter (Pos. 15R) and Supplying 115 Voltage to SIV (Pos. 44P) Power Unit

AG. Signalling Lamps (Pos. 12B, 13B), PUS-36 (Pos 16B and 17V), Rockets

AH. K-13 Missile Heating Elements

AI. Cannon Electric Trigger (Pos. 27P), Cannon Ready Lamp (Pos. 37P), Electrohydraulic Valve (Pos. 40P), Relay (Pos. 38P)

AK. Filament Circuits of K-13 Missile and EPU-13 in the APU-13 Launch Mechanism

AL. K-13 Missile Launch Circuits

AM. Aerial Camera (Pos. 1F and 2F)

AN. 685000/A Electrohydraulic Valves (Pos. 62M, 6T), Fire Extinguisher Cylinders (Pos. 23K)

AO. Signal Transmitters (Pos. 1K, 15K), 22DM-250 (Pos. 11K)

AP. KM-50D Contactor (Pos. 12M), Signal Lamp (Pos. 6K)

AQ. KM-50D Contactor (Pos. 17M), Signal (Pos. 4K)

AR. Electrohydraulic Valves (Pos. 23M, 92M, 22M) for Release of Landing Gear Wheel Brakes, Relays (Pos. 83M, 134M)

AS. KAF-13D Hydraulic Retarder Limit Switch (Pos. 97M), Carburetors (Pos. 56), KVS-1 (Pos. 151M), GA-164 (Pos. 153M)

AT. EUP-53 (Pos. 6N), Generator Switch Lamp of T-6 Register (Pos. 47S), Relay (Pos. 17E and 35E), KLSRK-45 (Pos. 1S)

AU. KPR-15A (Pos. 4M), AV7-44-5 (Pos. 1M), GSR-ST-12000VT [Generator] "Sh" Winding and Other Starter Units

AV. KM-50D Contactor (Pos. 6M)

AW. 3V Relay, R_{10}, R_{13}, 3 Boxes (Pos. 4M), Valve (Pos. 63M)

AX. [Illegible] 5A

AY. [Illegible] 5A

AZ. Pump 1 5A

BA. Pump 3 5A

BC. Automatic Wheel Brake Release 10A

BD. [Illegible] 10A

BE. [Illegible]

BF. Starter Units 75A [?]

BG. Pump 2 5A

BH. Starter [Illegible] 10A

cockpit. Distribution of direct current to the electrical equipment is made through the power unit busbar, which is connected to the starter generator and storage batteries.

To ensure its longer life, the airdraft electrical equipment is connected to source and load busbars No 1, 2, 3 (fig. 21).

To facilitate installation and dismantling of certain units and wire [P 74] bundles on aircraft, types ShR and ShRG plug connectors and also other types of connectors have been installed.

All aircraft electrical connectors should be well connected, and the sleeve nuts should be tightened as much as possible and locked.

A diagram indicating the location of electrical connectors is shown in fig. 22.

If there is a break of the conductors in the low temperature zone near a soldered joint, solder only with POS-40 solder with flux (alcohol-rosin mixture); after soldering carefully remove excess solder and flux.

Solder with PSR-2.5 solder in a high temperature zone.

Negative wires are connected with the aircraft frame with tips. To guard against corrosion and also to show where the negative tips are fastened, the places are painted with red-colored A-67F enamel.

Connection of the negative wires is made in the form of negative panels, where a whole number of negative wires from units located in proximity to each other come together, and in the form of separate points on the aircraft fuselage.

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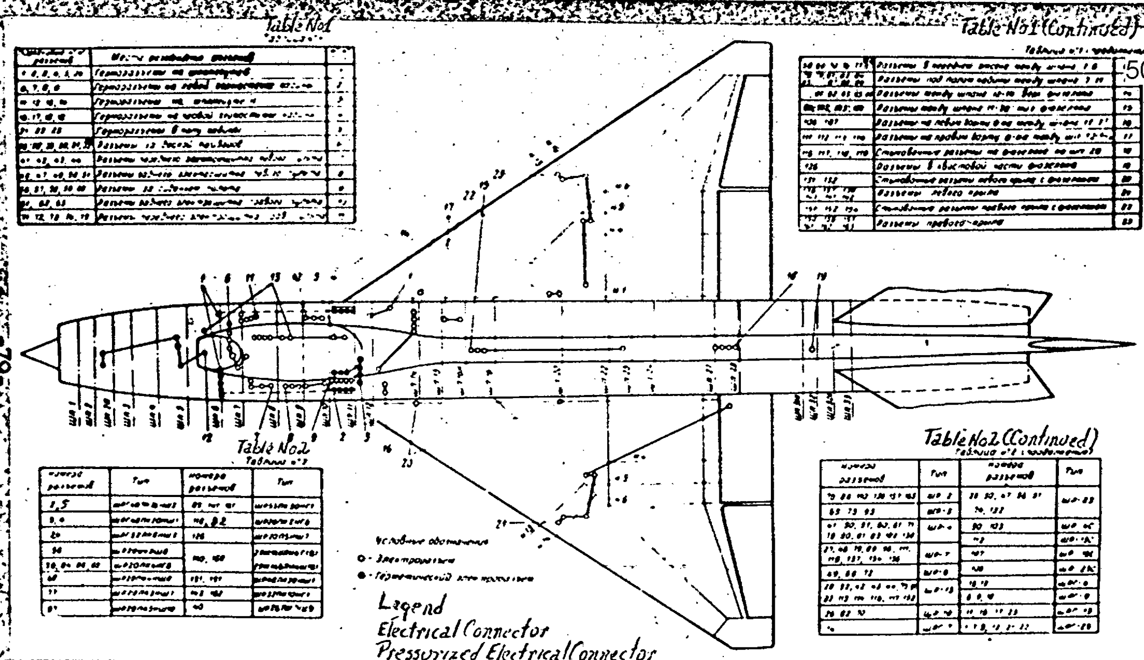

Fig. 22. Diagram Showing Location of Electrical Connectors.
Фиг. 22. Схема размещения электроразъемов.

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Fig. 22. Diagram Showing Location of Electrical Connectors.

Table No 1

Connector Numbers	Location of Connectors	No
1, 2, 3, 4, 5, 24	Pressurized Connectors on Frames	1
6, 7, 8, 9	Pressurized Connectors on Left [Two Word Illegible]	2
11, 12, 13, 14	Pressurized Connectors on Frame 11	3
16, 17, 18, 19	Pressurized Connectors on Right [Two Words Illegible]	4
21, 22, 23	Pressurized Connectors on Cockpit Floor	5
26, 28, 29, 30, 31, 32	Connectors on Instrument Panel	6
41, 42, 43, 44	Connectors of Forward Port Console Panel	7
46, 47, 49, 50, 51	Connectors of Rear Port Concole Panel	8
56, 57, 58, 59, 60	Connectors behind Pilot's Seat	9
61, 62, 63	Connectors of Rear Starboard Console Panel	10
71, 72, 73, 74, 75	Connectors of Forward Starboard Console Panel	11

Table No 1 (Continued)

68, 69, 70, 76, 77, 82	Connectors in Forward Compartment between Frames 1-6	12
78, 79, 81, 83, 84, 85, 87, 88, 89	Connectors under Cockpit Floor between Frames 7-11	13
91, 92, 93, 95, 98	Connectors between Frames 12-14, Upper Part of Fuselage	14

Table No 2

Connector Numbers	Type	Connector Numbers	Type
2, 5	ShRG48PK26NSh2	85, 141, 161	ShR55PK30NG1
3, 4	ShRG48PK20NSh1	118, 32	ShR20PK2NG6
24	ShRG32PK8NSh9	126	ShR20P5NSh7

58	ShR20[Three Letters Illegible]Sh8	140, 150	2RM14KPN4G181
59, 84, 80, 95	ShRPK4NG8		2RM14BLM4Sh181
68	ShR20PK4NSh8	131, 151	ShR48PK20NSh
77	ShR20PK3NSh7	142, 162	ShR32PK10NG1
87	ShR20PK5NSh10	40	ShR26PK[Two or Three Numbers or Letters Illegible]9

Table No 2 (Continued)

76, 88, 110, 136, 157, 165	ShR-2	29, 30, 47, 56, 57, 74, 132	ShR-23
63, 73, 93	ShR-3	90, 103	ShR-4S
41, 50, 51, 60, 61, 71, 78, 80, 81, 83, 102, 138	ShR-4	112	ShR-13S
27, 46, 79, 89, 96, 111, 119, 137, 154, 156	ShR-7	107	ShR-19S
49, 69, 72	ShR-9	106	ShR-23S
28, 32, 42, 43, 44, 75, 91, 92, 113, 114, 116, 117, 152	ShR-13	13, 19	ShRG-4
		6, 9, 18	ShRG-9

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26, 62, 70	ShR-19	11, 16, 17, 23	ShRG-13
14	ShRG-7	1, 7, 8, 12, 21, 22	ShRG-23

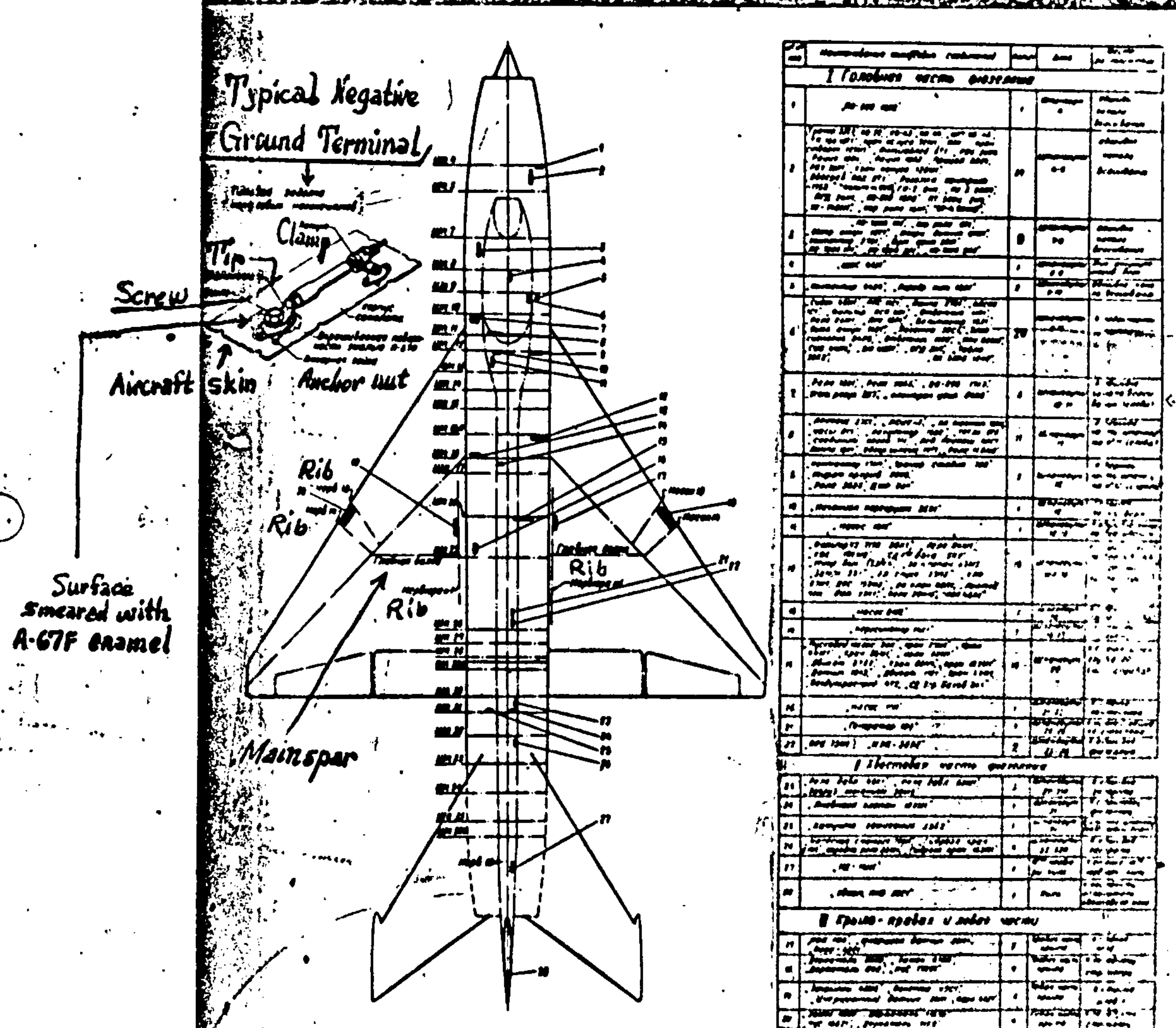

Figure 23. Diagram Showing Connection of Negative Terminal

Фиг. 23. Схема подключения минусовых клемм.

Fig. 23 Diagram Showing Connection of Negative Terminals

Position Numbers	Type Designation of Negative Connections	Quantity	Zone	Place of Attachment
	I. FUSELAGE NOSE SECTION			
1	PO-500 1502	1	frame No 4	to Engine Duct Lining
	Transf 23E1, KV-22, KV-43, KV 44, Sh 17, KV-45 TP-156 10T1, clutch cone valve 72M1 "ARK" Baffle valve 121M1, De-icer 6T1, "RVU" 3904, Radio set 10R4, Radio set 10R3, gun-sight 5A24, RVU 39R1, clutch cone valve 128M1	27	frames 4-5	to Engine Duct Lining
2	9T1 PVD preheater, Test and checking coupling 1158; SRO radio set filter, GA-2 8N4, PU-3, 25N4 AGD 24M1, PO-500 15R8, PT-500ts, 2N4, 3K-140 M1, 18 M1 short relay, "BR-4 50M19"			
3	PO-750A 1R3 short relay FR1	9	frames 7-8	to Engine Duct Lining
	Storage battery heater 1371, F1D1 Inertial Transmitter Contactor 2731, starter contactor 3831, PO 750A 1R1, PO 750 A 2R1, PO 750 A 2R3			
4	Shis 4131	1	frames 8-9	to upper part of storage battery bay
5	contactor 4434, airfield power source 1331	2	frames 9-10	Engine Duct Lining
6	seat 45M1, PPS-11S1, Lamp 2761, klsrk 1S1, Filter ASP 4L1, Responder 11R1, Relay 86M1, ARK-15R1, volt-meter 1631, storage battery switch 1431 receptable 36S1, signal unit 54R5, responder 11R2; ARU 62M3, SIV 44L1, VM43L1, AGD-3N1, Panel 30Ye2 VK-53R6 12N2	20	Frames 9-10	to panel beneath canopy

7	Relay 1831, relay 2065, DV-250 17K3, angle adjustment 397, electronic amplifier 24K5	5	frames 10-11	to Engine duct lining (port side)
8	ARUFOSh 37S1, RSIU, electro-magnet 15M1, clock VT1, regulator 1952, TRT8k 375, junction box 7N, port ARUFOSh 40S1, lamp 16K1, helmet heater 19T1, relay 116M2	11	Frame 11	to upper (port side) of frame No 11
9	Contactor 17M1, stabilization transformer 732 thyratron interruptor 20K6 relay 36E5 DMR 2E1	5	frame 12	to upper (starboard side) of frame No 12)
10	Overload mechanism 3561	1	frame 12	to port side of backfairing
11	Pump 16M	1	frames 12-13	to Engine Duct lining
12	Filter K2-717A 38K1 relay 84M1 KVS 151M9, SD1? of tank 5K2, Mike switch 133M4, electric valve 63M2 lock 561 electric starter 27L3, KAF 97M1, DOS 152M3, electrical valve 40L1, fire extinguisher tank 23K1, relay 29M10, AZL4601	13	frames 16A-16	To engine duct lining and to wall of container(Starboard
13	Pump 8M2	1	frame 16	to wall of frame No 16 (port side)
14	kerosene gage 14K1	1	frames 16-17	to upper panel
15	Starter pump 2M1, valve 27M1, valve 44M1, valve 36M1, valve 32M1, engine 32Ye2, valve 82M1, valve 122M1, transmitter 12K3, engine 11Ye1, valve 52M1, air distributor 4T2 SD 3gr of tanks 3K1	13	frames 20	to wall of frame No 20 (lower right)
16	Pump 11M	1	frames 21-22	to wall of container

21	Generator 193	1	frames 25-26	to lower fuselage skin
22	ARU 73M1, MRP-59R2	2	frames 25-26	to fuselage skin

II. FUSELAGE TAIL SECTION

23	Pressure relay 46K1, pressure relay 60M1 loading mechanism 58M2	3	frames 30-31A	to backfiring skin
24	pneumatic electric valve 132 M1	1	frame 31	to suselage stringer
25	Ignition coil 33Ye2	1	frame 31	to wall of frame 31 port side
26	Pump station 79M1, hydraulic electric valve 81M1, relay box 85M1, hydraulic electric valve 153M1	4	frames 32-32A	to backfiring skin
27	MD-14M1	1	10th spar of tailfin	to wall of 10th spar of tailfin
28	tail ANO 20S1	1	tail fin	at fairing line of tail

III. PORT AND STARBOARD WING SECTIONS

17	AFP1F2, Inertial transmitter 25M1, light 43S1	3	starboard wing section	to wall of Rib No 3
18	pylon 8690, lock 4158, pylon 859, PUS 17621	4	starboard wing section	to forward stringerrd
19	Flaps 43M2, receptable 45S1 inertial transmitter 23M1, light 44S1	4	port wing section	To Rib No 1 stringer
20	Lock 4068, pylon 11530 PUS 16521, pylon 1159	4	port wing section	to forward stringer

A diagram indicating connections of negative wires to aircraft fuselage is given in fig. 23.

During operation, it is necessary systematically to check the reliability of the flange and connection of current source and consumer equipment negative wires to the aircraft fuselage.

In case they have loosened, clean the contact surfaces, tighten them up and again paint them with A-67F enamel.

Make sure there is a space between the wire harnesses and kerosene or hydraulic lines; it should not be less than 30 millimeters. In those places, where it is impossible to have a space of 30 millimeters, the wire harnesses and kerosene and hydraulic lines must be protected with artificial leather or two layers of insulating tape. [P 77]

The wire harness protectors should be checked (especially when they are moved near sharp edges of aircraft).

If protectors are damaged, they should be repaired and the cause of the damage eliminated.

Check that there is no weight on the wire harnesses in places where conductors are soldered and in places where wires connect to electrical unit terminals and negative terminals.

Do not leave extraneous items in places where electrical and radio equipment units and their wire harnesses are located.

The removal of dust and dirt by compressed air from aircraft equipment sections is absolutely forbidden.

CHAPTER IV

PREPARATION OF AIRCRAFT ELECTRICAL EQUIPMENT FOR FLIGHT

Initial Preparation

Inspect and Check:

Nose Landing Gear Strut

1. Mounting, operation, and smoothness of movement of stems of landing gear position terminal switches.

2. Good working conditions and mounting of fixtures and glass of landing gear exterior signalling light.

3. Flange and condition of wire harness protective covers.

Right Landing Gear Strut

4. Mounting, operation, and smoothness of movement of stems of landing gear position terminal switches.

5. Good working condition and mounting of fixtures and glass of landing gear exterior signalling light.

6. Flange and condition of wire harness protective covers.

Right Wing

7. Condition and clearness of BANO light filter and fixtures.

Condition and clearness of landing and taxiing light glass.

Right Side of Fuselage

8. Flange and condition of wire harness protective covers in engine section.

Empenage

[P 79]

9. Good working condition, mounting, and clearness of light filter of navigation light fixtures.

Left Side of Fuselage

10. Flange and condition of wire harness protective covers in engine section.

Left Wing

11. Condition and clearness of BANO fixture light filter.

12. Mounting and condition of landing light glass (landing and taxiing light).

Left Landing Gear Strut

13. Mounting, operation, and smoothness of movement of stems of landing gear position terminal switches.

14. Good working condition and mounting of fixtures and glass of landing gear exterior signalling light.

15. Flange and condition of wire harness protective covers.

Lower Equipment Section

16. Condition, mounting, and effectiveness of lock unit of airfield power source connector, and condition of connector prongs of airfield power source.

17. Mounting of storage batteries.

18. Reliability of connection of connectors to storage batteries, and condition of thermorelay protective jacket.

19. Flange and condition of insulation of wire harness and wires.

20. Reliability of connection of storage battery negative wire. [P 80]

Aircraft Cockpit

21. Position of voltmeter needle with a dead electrical circuit.

22. Voltage of storage batteries under load. Switch on switch for "Aircraft Battery-Airfield", and then the following automatic cut-outs: "Radio Set, Oil Pressure Gauge", "Pump No 2", "Pump No 3" (not more than 2-3 seconds) - voltage of storage batteries should not be less than 21 volts.

23. Mounting and good working condition of ARUFOSh and KLSRK fixtures, RUFO rheostats, and buttons. Check fuse and relay box locking pieces.

24. With the airfield electric power source switched on, check:

- operation of fuel booster and transfer pumps, their signalling;
- good working condition of signalling lamps on T-6 and T-4 registers;
- good working condition of ANO and UFO lamps and cockpit lighting;
- operation of lights, landing gear position signalling, and exterior landing gear signalling;
- operation of flap signalling and air brakes;
- emergency converter switching;
- operation of distributor valve of aircraft supply system.

When this work is completed, make sure that the "Trim Tab Effect" electromechanism is in the neutral position and switch off all power consuming equipment and aircraft storage batteries.

Preflight Preparations [P 81]

Inspect and Check:

Nose Landing Gear Strut

25. Glass in fixture of landing gear exterior signalling.

Right Landing Gear Strut

26. Glass in fixture of landing gear exterior signalling.

Right Wing

27. Light filter of navigational lights and MPRF-1A landing and taxiing light.

Empenage

28. Light filter of navigation lights.

Left Wing

29. Light filter of navigation lights.

30. MPRF-1A landing and taxiing lights.

Left Landing Gear Strut

31. Glass in fixture of landing gear exterior signalling.

NOTE: When checking the lighting fixtures make sure of the condition and cleanliness of glass and light filters

Lower Equipment Section [P 82]

32. Mounting of aircraft storage batteries, reliability of plug connector connections, drain line, lock unit of insulation cover.

NOTE: If the storage batteries have been taken off the aircraft, make sure of their charge level, and check reliability of connections to storage battery terminals. After this, put them on the aircraft, enclose them with insulation cover, and connect to aircraft main circuit. Set needle on ISA scale at number to number of ampere-hours of storage batteries.

Make a cell-by-cell check of storage batteries, and then check mounting of checking connector.

Aircraft Cockpit

33. Voltage of storage batteries. To do this, switch on "Aircraft Battery - Airfield" switch, and then following automatic cut-outs: "Radio, Oil Pressure Gauge", "Pump No 2", "Pump No 3" (no longer than 2-3 seconds) - voltage of storage batteries should not be less than 21 volts.

34. Mounting of ARUFOSh and KLSRK fixtures, condition of wires leading to them, good working condition and cleanliness of caps of all light filters and signal lamps.

35. With the airfield electric power source turned on, check:

- operation of landing gear signalling;
- good working condition of signalling lamps in "T-6" and "T-4" registers; [P 83]
- good working condition of ANO and UFO lamps and cockpit lighting;
- operation of fuel booster and transfer pumps, their signalling;
- signalling of main hydraulic system and hydraulic booster system;
- emergency converter switching.

/ Take-Off Inspection and Between Flight Preparations

In prearing for a second flight, check the good working condition and mounting of terminal switches, flange and condition of wire harness protective covers on landing gear struts.

Check how well the ampere-hours integrating meter (ISA) works.

Before each start of the engine, check the condition of prongs of airfield power source connector and wipe them with alcohol.

Do the work mentioned in the "Preflight Preparations" section; do not do No 32, 34, 38 if the pilot does not complain about the operation of these units.

Work Done When Transferring an Aircraft from One Shift to Another

When transferring an aircraft from one shift to another, do the work mentioned in "Between Flight Preparations" section.

CHAPTER V

SCHEDULED MAINTENANCE WORK

Work done on non-flying days ("✓" sign means work done)

No	Work Done	Every 7 plus 3 days	Every 30 plus or minus 5 days	Every 3 mos plus or minus 10 days
1	2	3	4	5
1	Check condition of storage batteries: cleaness of covers, plates, busbars, inter-cell connections; tightness of all nuts, electrolyte level, voltage under load, good working condition of springs	✓	✓	2
2	Check condition of insulation cover; "lightning" locks, good working dondition of battery cover heating, and wires to cover (adjust heating).	✓	✓	✓
3	Check automatic operation of ARU [auto-gain control] dynamic head	✓	✓	2
4	Check mounting of starter-generator, mounting and flange of pipe connection, tightness of wires		✓	2
5	Blow out storage battery drain system with compressed air.		✓	✓
6	Check exterior condition and mounting of air temperature control in cock-pit, RP-2 relay unit, air distributor electric motor. Check time required for full switch-over of air distributor from one line to another; it should be within limits of 20-40 seconds.		✓	2
7	Check mounting of starter and booster ignition coils.		✓	✓

[P 85]

8 Remove starter-generator protective band, inspect condition of commutator, brushes, and brush springs. +

9 Blow out interior cavity of starter generator with compressed air (pressure of 2-2.5 kg/cm^2). +

10 Check condition and mounting of carbon-pile voltage regulator, differential under-voltage relay, capacitors, stabilization transformer; check tightness of clamping bolts and soldering of wire tips. +

11 Check switch on of generator into aircraft main circuit with the engine idling; with engine operating check adjustment of voltage regulator, generator voltage should be within limits of 28.5+0.5 volts at idle with a load of 120 amperes and without a load at rated rpm's of engine. +

12 Check good working condition of mechanical part of automatic cut-outs, switches, and make sure they are fastened securely. + [P 86]

13 Check large and small arms of ARU-3V, which should be 100 plus or minus 0.5 mm and 50 plus or minus 0.5 mm respectively. +

NOTE: The aircraft stick control should be near the neutral position and loose when checking automatic operation of automatic gain control without pressure in hydraulic system.

14 Check the accuracy of performance of the automatic gain control follow-up system with a slow (60-90 seconds) change of pressure in the dynamic head MRD-106 transmitter, corresponding to the change of instrument speed from 420-510 to 990-1,040 km/hr and back. When this is done, the pressure in the static cavities of MRD-106 and MRD-126 transmitters should be at atmosphere level and the number of switch-ons should be not less than 18 and not more than 35 with an identical direction of pressure change. +

15 Check the accuracy of ARU correction performance for altitude with a constant transfer of pressure in the dynamic cavity of the MRD-106 transmitter, corresponding to an instrument speed of 990-1,040 km/hr. +

16 Check control circuits for automatic operation of ARU-3V. + [P 87]

17 Together with aircraft technician, check system for automatic release of wheel brakes, control of jet nozzle petals and operation of after-burner units. +

18 Check fire signal. +

Work done on flying days ("+" sign means work done)

No	Work Done	Every 50 plus or minus 5 hours	100 plus or minus 10 hours
1	2	3	4
	Starter Generator and Equipment Operating in conjunction with it		
1	Remove starter generator from aircraft and check: - whether the armature jams when you turn it with your hand; - condition of textolite panel and terminal bolts; - ease of movement of brushes in brush holder seats, condition of brushes and brush stranded conductors; - measure and record length of brushes and their wear after 50 hours of operation on aircraft.	+	+
2	Together with aircraft technician, check performance of engine starting system (starting on ground and in air). Turn aircraft engine over from starter generator. Check self-starting of engine.	+	+ [p 88]
3	Check condition of shock absorbers and mounting of carbon-pile voltage regulator panel.	+	+
4	Check parameters of carbon-pile voltage regulator on installation; without installation, but with earphones, listen to operation of voltage regulator and from sound in earphones make sure there is no popping and sparking between regulator carbon disks	+	+

5	Check condition of contactor contacts of differential under-voltage relay	+	2
6	Remove and check exterior condition of differential under-voltage relay, value of cut-in and cut-out voltage, check cut-out of differential under-voltage relay with back current.		+
	Switching Equipment		
7	Together with aircraft technician, check adjustment of terminal switch stems of landing gear struts, flaps, and landing brakes.	+	2
8	Check mounting of relay boxes, insulation on wire harnesses, and their flanges.	+	+
9	Check exterior condition and mounting of of contactors and reliability of electric wire connections.	+	+
10	Remove contactors, check condition of their contacts and disengagement of contactors.		+
11	Check voltage drop at busbars of control button "Trim Tab Effect", (voltage drop should not be more than 90 millivolts).		+
	ARU-3V Automatic		
12	Check large and small arms of ARU-3V, which should be 100 plus or minus 0.5 mm and 50 plus or minus 0.5 mm respectively.	+	+

[p 89]

NOTE: The aircraft stick control should be near the neutral position and loose when checking automatic gain control/without pressure in hydraulic system.

13 Check the accuracy of performance of the automatic gain control follow-up system with a slow (60-90 seconds) change of pressure in the dynamic head MRD-106 transmitter, corresponding to the change of instrument speed from 420-510 to 990-1.040 km/hr and back. When this is done, the pressure in the static cavities of MRD-106 and MRD-126 transmitters should be at atmosphere level and the number of switch-ons should be not less than 18 and not more than 35 with an identical direction of pressure change.	+	+	[p 90]
14 Check the accuracy of ARU correction performance for altitude with a constant transfer of pressure in the dynamic cavity of the MRD-106 transmitter, corresponding to an instrument speed of 990-1,040 km/hr.	+	+	
15 Check manual control circuits of ARU-3V automatic	+	+	

Units of Cockpit Power Supply System

16 Blow out inner cavity of air distributor electric motor with compressed air (at pressure of 1-1.5 kg/cm^2).	+	+
17 Inspect and if necessary clean the contacts of the TRTVK-45M thermostat.	+	+

/

"Trim Tab Effect" and Seat Control Electromechanisms, Bump Station Electric Motor [p 91]

18	Check exterior condition, mounting, and condition of plug connector, and tightness of sleeve nuts.	+	+
19	Check exterior condition of commutator, brushes, brush springs, measure length of D-880 electric motor brushes. Remove brush dust from electric motor parts with compressed air (at pressure of 1-1.5 kg/cm^2).		+
	Check the amount of current used by electromechanisms and electric motors.		

PO-750A Converter

20	Remove the converter, inspect the commutator-brush assembly, check the condition and ease of movement of the brushes, measure their wear, replace brushes having less than allowable length.	+	+
21	Check and if necessary clean the commutator and contact rings, clean spaces between commutator segments. Blow out converter with compressed air (at pressure of 1-1.5 kg/cm^2).	+	+
22	Together with radio and armament specialists, check the value of converter output voltage on the aircraft.	+	+

Starter and Booster Coils [p 92]

23	Remove starter and booster coils and check condition of interrupter contacts and efficiency of coils. If necessary clean the interrupter contacts and adjust current in primary winding of coil.	+	+

50X1-HUM

	Fuel Pump Electric Motors			
24	Make sure there is no fuel inside electric motor.	+	+	
25	Check condition of commutator and brushes, blow out internal cavity of electric motors with compressed air (at pressure of 1-1.5 kg/cm^2)	+	+	
26	Check amount of current, used by each electric motor	+	+	
	NOTE: Do not do work in No 24 and 25 on units 422P and 495A if there are no complaints			
	Exterior Illumination and Signalling Equipment			
27	Check condition of packing gaskets of BANO and KhS fixtures and exterior signalling of landing gears	+	+	
28	Remove landing light bulb, open contadt section of electromechanism and check condition of contact sectors, connection of wires to terminals, condition of commutator, brushes, and their springs. Blow out inner cavity of electric motor with compressed air (at pressure of 1-1.5 kg/cm^2).		+	[P 93]
29	Check performance of programmed work, disengagement time, amount of current used by electromechanism controlling landing light.		+	
30	Check adjustment of landing lights on aircraft with respect to check points		+	

/

Fire Signalling System

31	Check mounting and external condition of amplifier and transmitter, condition of wiring leading to them, wipe off the transmitters.	+	+
32	When the transmitter is disconnected from the amplifier, determine the resistance value, at which fire signalling occurs.	+	+
	Check insulation resistance of wire harness from transmitter to oil pressure gauge indicator for 500 volts. Check functioning of fire signalling.	+	+

Electric Filters [P 94]

33	Open filter covers, inspect wiring, blow out with compressed air, check how well electric wires are connected, and check condition of filter bonding.		+

Aircraft Main Electrical Circuit

34	Check mounting of plug connectors, tightness of sleeve nuts, condition of straps, clamps, and gaskets under clamps	+	+
35	Check exterior condition of electrical panels, electrical distribution devices, and their apparatuses.	+	+
36	Inspect shielded sections of electrical circuit and make sure that the sheathing is in good shape and that the shielded sections are connected to each other and the aircraft fuselage.	+	+

37	Check condition of wiring in electrical panels and control panels, reliability of attachment of tips to wires, blow out interior cavities of electrical panels and control panels with compressed air (at pressure of 1-1.5 kg/cm^2).	+	+	
38	Check condition of insulation of open sections of main electrical circuit.	+	+	
39	Check exterior condition and mounting of wires to ampere meter and ISA shunts.	+	+	[P 95]
40	Check mounting of fuses and condition of wires in the port and starboard power units.	+	+	
41	Check connection of negative wires of power sources and electrical equipment to aircraft fuselage. In case there is a bad connection, clean off contact surfaces, tighten them and repaint.	+	+	
42	Check condition of receptacles and jacks of connectors and pressure tight connectors.		+	
43	Check tightness of screws in terminals.		+	
44	Check wire tips.		+	
45	Open landing gear and flap signal boards, and "T-4" and "T-6" registers, check cleaness, mounting, and mounting of fixtures in them.		+	

NOTE: After doing the scheduled maintenance work and inspection of the aircraft fuselage, check the electrical equipment with the amount of current of preflight preparations.

Servicing of Electrical Equipment When Aircraft is Stored [P 96]

Every 10 plus or minus 2 days

1 Do the work done in preflight preparations

Every 30 plus or minus 5 days

2 Do the work done in preflight preparations and check the efficiency of all the electrical equipment with current from airfield power source. Check performance of automatic gain control dynamic head.

Every 3 months plus or minus 10 days

3 Open electrical panels and check wiring.

4 Inspect and check plug connectors at inspection stations.

5 Check efficiency of all electrical equipment with current from airfield power source.

[p 97]

PART TWO

RADIO EQUIPMENT

[p 98]

GENERAL INFORMATION ON THE RADIO EQUIPMENT

The following radio equipment is installed on the MIG-21F-13 aircraft:

1. The RSIU-5G ultra short-wave radio set.
2. The ARK-10 automatic radio compass.
3. The MRP-56P marker beacon radio receiver.
4. The RV-UM radio altimeter.
5. The SRO-1 responder radar.
6. The SRD range only radar.

The above-mentioned aircraft radio equipment permits solution (during both night and day) of the following problems:

1. Maintenance of two-way contact between aircraft and ground radio stations (RSIU-5G).

2. Flying the aircraft by both homing and broadcast radio stations and by means of the radio beacon (ARK-10).

3. Signaling the passage of the aircraft over a marker beacon radio (MRP-56P).

4. Determination of the exact altitude of the aircraft over the surface of the ground and signaling descent to a predetermined "dangerous" altitude (RV-UM).

5. Take-off and landing with the use of a simplified landing procedure (employing the ARK-10, the RV-UM, and the MRP-56P).

[p 99] 6. Initiation of radar response to challenges from other aircraft,

and from ground and shipboard interrogator radars (SRO-1).

7. Automatic and continuous determination of the range to the target and of its relative velocity by feeding into the sight computer voltages proportional to the range values being determined; and the determination of the right momemt to effectively launch the homing missile (SRD).

To reduce radio interference and to ensure dependable operation of radio equipment, MIG-21F-13 aircraft are equipped with static discharge tabs at tips of wings and on stabilizers and vertical fins.

The location of radio equipment components is shown in figure 24.

The location of radio antennas is shown in figure 25.

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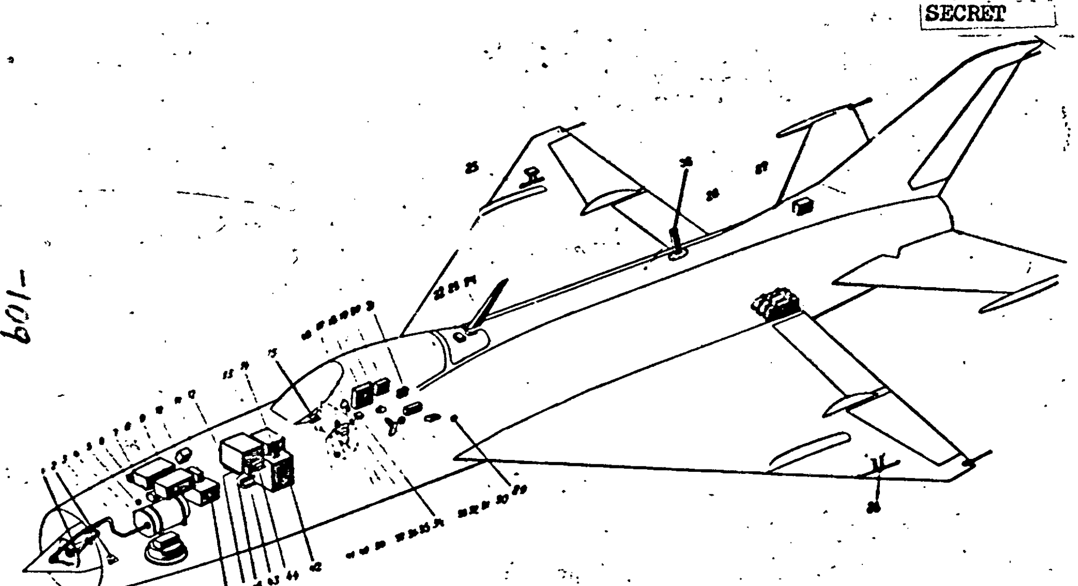

Фиг. 24
Fig 24

Лист №100

Фиг 24. Размещение агрегатов радиотехнического оборудования.

Fig 24 Location of radio equipment components [p 101] Captions to Numbers on Fig. 24 on the Preceding Page Showing Locations of Aircraft Radio Equipment

1. Combination antenna and waveguide channel of the range only radar.

2. P-5 temperature receiver (SRO).

3. Directional loop antenna unit (ARK-10).

4. RB6-2M transceiver unit (SRD).

5. Monitor connection (SRD).

6. K-6 monitor and adjustment panel unit (SRD).

7. RB6-5 velocity unit (SRD).

8. RB6-3 range receiver unit (SRD).

9. RB6-4 power unit (SRD).

10. Power unit (ARK-10).

11. K-8 comparator unit (SRD).

12. Transceiver (RSIU-5G).

13. ARK-10 receiver.

14. Detonation circuit control board (SRO-1).

15. UAP-1 universal automatic switch for the ARK-10 radio compass.

16. MARKER signal lamp (MRP).

17. UD-1 range indicator (SRD).

EFFECTIVE RANGE signal lamp (SRD).

DISENGAGE signal lamp (RSD).

18. Control panel (ARK-10).

19. Tuning indicator (ARK-10).

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20. Code panel (SRO-1).

21. Signal unit (MRP-56P).

22. Antenna amplifier (ARK-10)

23. AF-1 filter for the common rod antenna.

24. Common rod antenna.

[p 102] 25. Receiver antenna (RV-UM).

26. Intrafuselage antenna (MRP-56P).

27. Receiver (MRP-56P).

28. Transmitting antenna (RV-UM).

29. Decoupling transformer (RSIU-5G).

30. UK-2M amplifier (RSIU-5G).

31. RSIU-5G radio control panel.

32. (PVD, Pereklyuchatel' Voln Distantsionnyy) REMOTE FREQUENCY SELECTOR switch (ARK-10).

33. Button for switching the RSIU-5G radio set to the transmitting mode.

34. DETONATE button

35. SHORT RANGE -- LONG RANGE switch (ARK-10).

36. UGR-4U course indicator (of the KSI set).

37. UV-57 altimeter (RV-UM).

38. SRO-1 responder antenna.

39. Signal lamp (RV-UM).

40. PSV-UM radio altimeter DANGEROUS ALTITUDE switch.

41. ARK-BPRS signal lamp (ARK-10).

42. Transceiver (SRO-1).
43. DVS-5 air-speed transmitter (SRD).
44. VRD-2A effective range computer (SRD).
45. Inertial locking device (SRO-1).
46. VChF-3 filter of the RV-UM radio altimeter.
47. PP-U transceiver unit of the RV-UM radio altimeter.

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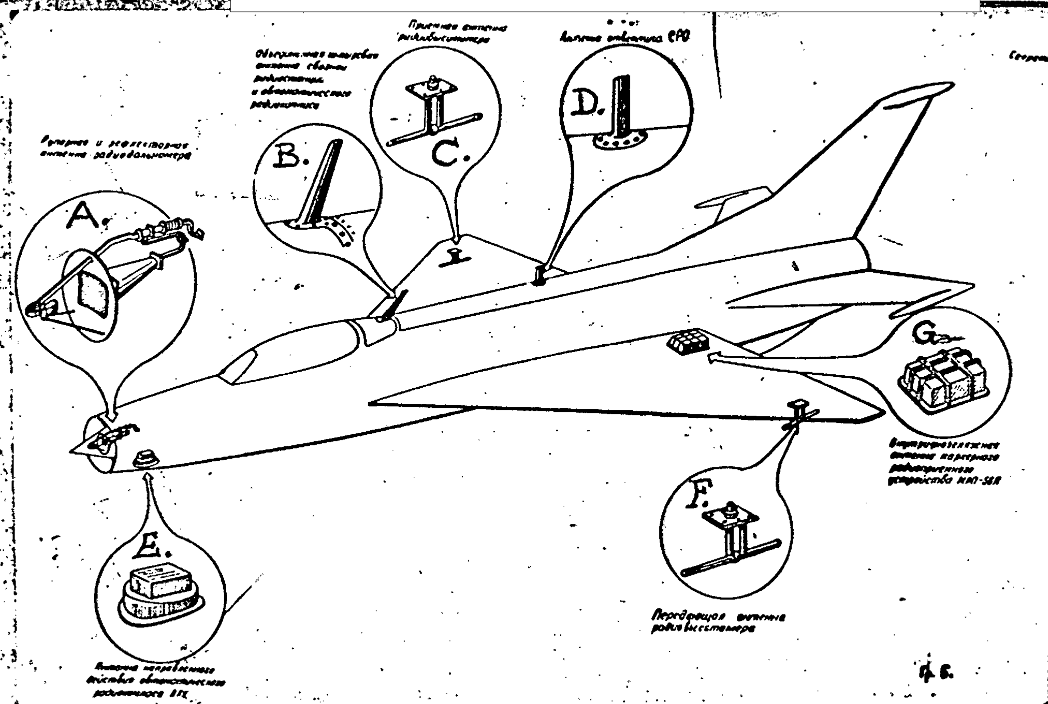


Фиг. 25. Размещение антенн радиотехнического оборудования.

Fig 25 Location of radio equipment antennas [p 103] Captions to Letters on Fig. 25 Showing the Location of Radio Equipment

Antennas

A. Range-only-radar horn and reflector antenna.

B. Common rod antenna of the communications radio and the automatic radio compass.

C. Radio altimeter receiving antenna.

D. SRO responder radar antenna.

E. ARK automatic radio compass directional antenna.

F. Radio altimeter transmitting antenna.

G. Intrafuselage antenna of the MRP-56P marker beacon radio receiver.

[p 104]

Chapter I

The RSIU-5G Radio Set

1. General Information

The RSIU-5G ultra short-wave radio transceiver provides two-way radiophone communications on the 2-3-meter (100-150 megacycle) wave band, which encompasses 501 communication channels evenly distributed over the wave band employed and stabilized by quartz crystals (forming a stable grid of channels every 100 kilocycles).

Quartz-crystal frequency stabilization makes it possible to establish communications during flight without scanning and to maintain them without tuning.

The radio set makes it also possible to pretune on the ground to 20 preselected communication channels and to utilize any of them during flight. Switching from one channel to another is done with the P-1 CHANNEL switch on the control panel, where the number of the selected channel appears in a small window. Switching from one channel to another is accomplished within a span of no more than 4 seconds.

To a ground station, the RSIU-5G radio set provides two-way communications at full power on the order of 18-20 watts to distances of at least 350 kilometers at an altitude of 10,000 meters; between aircraft,

[p 107] the set provides two-way communications to distances of at least 120 kilometers at altitudes of 500 meters and higher.

Radio communication may be carried out either by means of a pressurized helmet with earphones and a microphone, or with a helmet with a laryngophone and earphones.

Normal operation of the radio set is ensured by forced-air ventilation of the transceiver housing with a stream of air at temperatures no greater than $+50^{\circ}$ C (See figure 26).

While testing the RSIU-5G radio set on the ground, it may be operated without forced air ventilation, but for not more than 20 minutes as follows:

one minute in the TRANSMITTING mode,

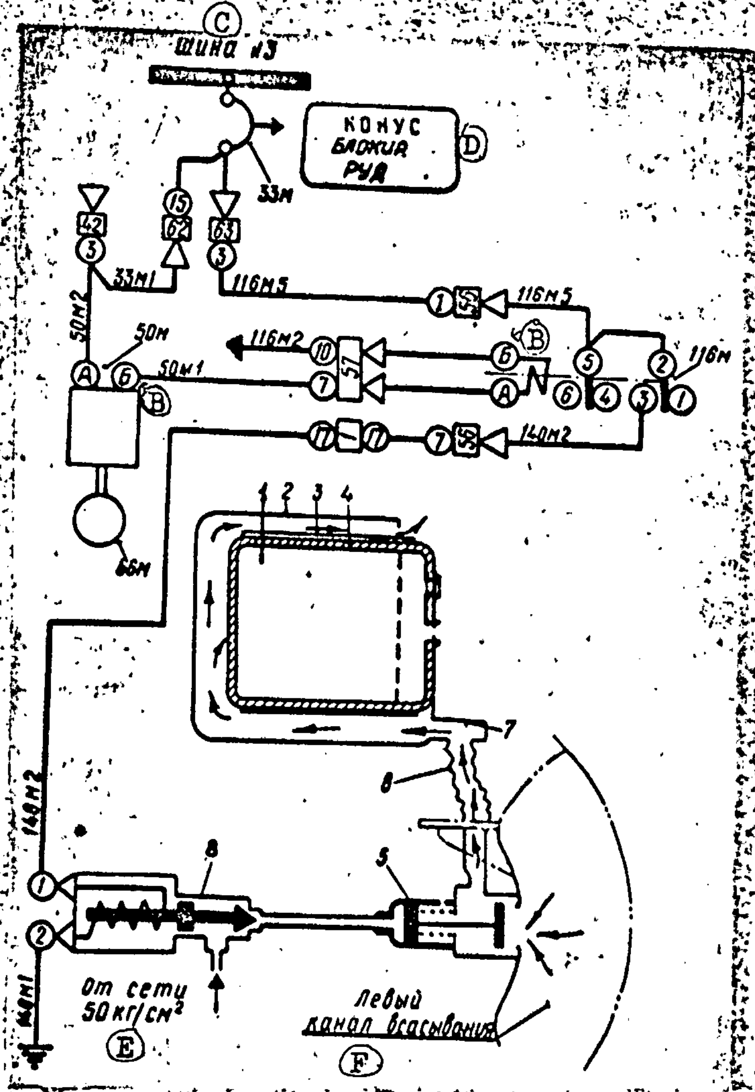
3 minutes in the RECEIVING mode,

but not more than 30 minutes [of continuous operation] in the RECEVING mode [alone].

The RSIU-5G radio set installed in aircraft consists of the following components (See figure 27):

1. ABV transceiver with power supply unit.
2. P-1 control panel.
3. Series B, UK-2M amplifier.
4. Decoupling transformer.
5. Rod antenna (common to the RSIU-5G and the ARK-10).
6. AF-1 separation filter.
7. Complex of wire harnesses and feeder cables.

[Note: Components 5, 6, and 7 are not identified in figure 27.]



Фиг 26 Схема обдува радиостанции РСИУ-5Г

Fig. 26 RSIU-5G Radio Set Ventilation Diagram

SECRET

Captions to Letters and Numbers on Fig. 26 on the Preceding Page Showing the Layout of the RSIU Transceiver Ventilation System

[p 105] A. A

B. B

C. Bussbar 3

D. RUD clutch cone

E. From 50 Kg/cm^2 supply system

F. Left intake channel

[p 106] 1. Transceiver

2. Outer wall of housing

3. Channel beam

4. Inner wall of housing

5. Cut-off valve

6. Flexible hose

7. U-shaped connecting pipe

8. EK-65 electric valve

33M. THROTTLE-LEVER INTERLOCK-CLUTCH automatic circuit breaker (AZS)

50M. Machmeter setting device circuit filter

66M. Machmeter setting device

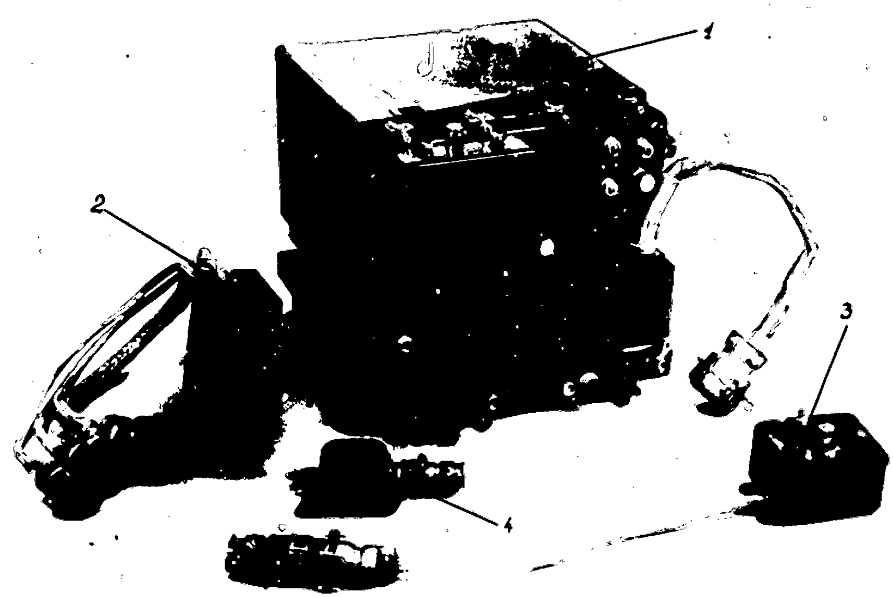
116M. TKE-52PD relay.

[Other numbers on the figure are not identified.]

50X1-HUM

50X1-HUM

SECRET



ФИГ.27. КОМПЛЕКТ РАДИОСТАНЦИИ РСИУ-5Г
1.- ПРИЕМОПЕРЕДАТЧИК; 2.- ПУЛЬТ УПРАВЛЕНИЯ; 3.- УСИЛИТЕЛЬ УК-2М;
4.- РАЗДЕЛИТЕЛЬНЫЙ ТРАНСФОРМАТОР

Fig 27 The complete RSIU-5G radio set:
1. Transceiver, 2. Control panel, 3. UX-2M amplifier, 4. Decoupling transformer

[p 109]

2. Location of Radio Set Components on Aircraft

The location of components of the RSIU-5G radio set on aircraft is as follows (See figure 28):

1. The transceiver (the ABV unit) is mounted in the upper equipment bay directly under the equipment access cover between frames 4 and 5.

2. The P-1 control panel is installed in the cockpit on the vertical part of the port cockpit console between frames 8 and 9.

3. The TRANSMITTING MODE button of the RSIU-5G radio set is placed in the cockpit at the port cockpit console on the engine throttle lever handle (gas sector).

4. The common rod antenna of the RSIU-5G and the ARK-10 radio sets is affixed to the rear stationary part of the canopy between frames 13 and 14.

5. The AF-1 separation filter of the common rod antenna is shielded and is located on the rear stationary part of the canopy between frames 13 and 14. It is fastened to the common rod antenna.

6. The UK-2M amplifier is mounted in the cockpit on the port cockpit console at frame 10.

7. The decoupling transformer is installed on the port side of the cockpit between frames 10 and 11.

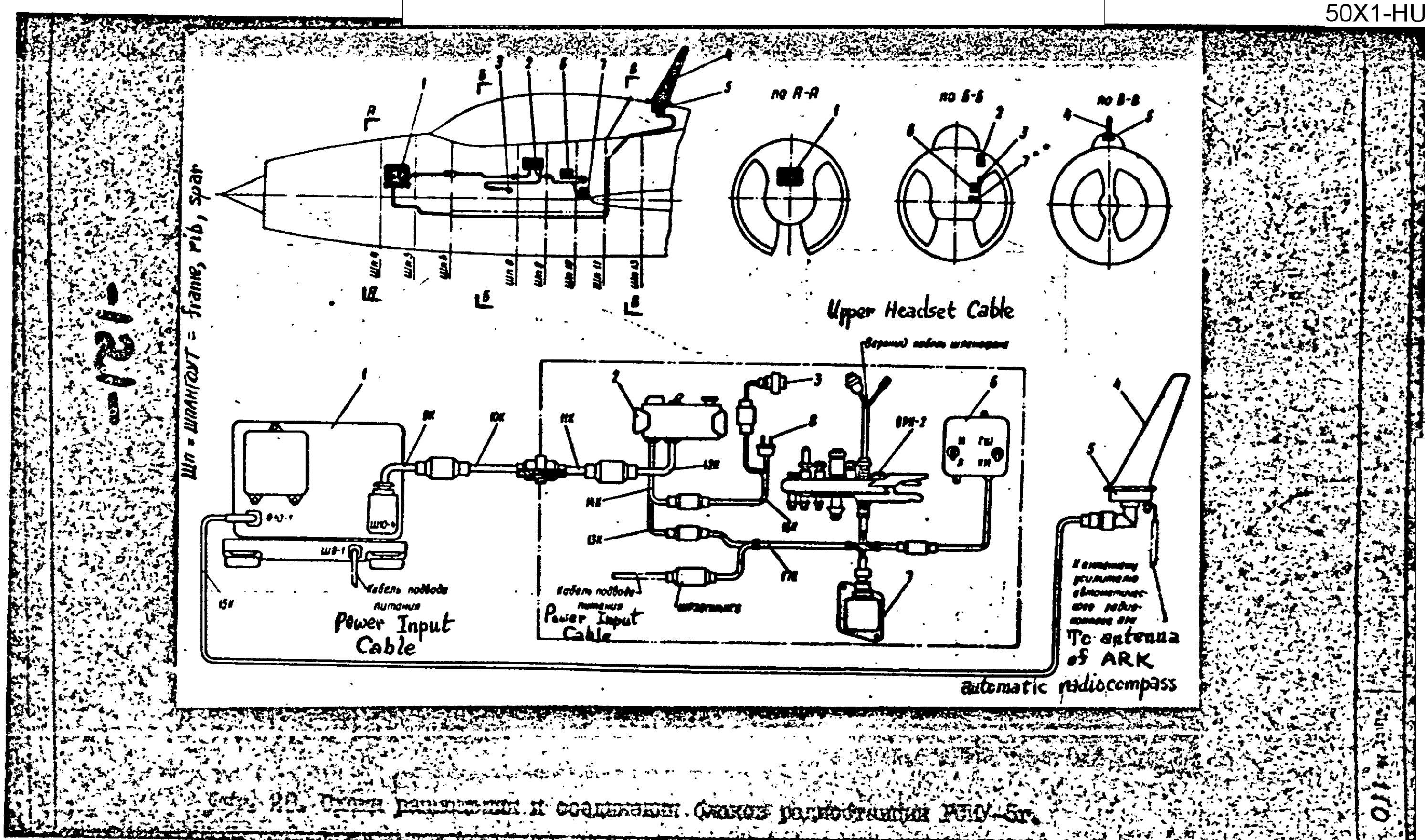


Fig. 28 Location and cabling of RSIU-5G radio set components

[p 111] Captions to Numbers on Fig. 28 on the Preceding Page Showing the Location and Cabling of RSIU-5G Radio Set Components

1. Transceiver (unit ABV).
2. Control panel
3. Radio TRANSMITTING MODE ON button
4. Common rod antenna of the RSIU-5G and the ARK-10
5. AF-1 filter
6. UK-2M amplifier
7. Decoupling transformer
8. Two-pin plug with lock screws

9k-17k. Complex of wire harnesses and feeder cables.

[p 112] 3. Radio Servicing and Maintenance

Precautionary Measures

When tuning, inspecting, repairing, and trouble-shooting the radio set, it is essential to remember that:

1. The radio set employs high voltages of both direct and alternating current of both high and low frequencies. High potential direct current is fed to the plates of the tubes and to the power supply terminals.

Radio frequency potential is present at the r-f connection of the antenna, at the antenna relay, and in the plate circuits of the transmitter.

2. The radio must be turned off when replacing fuses in the power unit.

3. The radio must be turned off when replacing tubes.

4. Plug and socket contacts must not be inspected or cleaned with the radio turned on.

5. Circuit grounding should be checked with the radio turned off.

Operating Procedure for the Radio Set

Operation of the RSIU-5G radio set has been reduced to a minimum number of steps as follows:

[p 115] 1. Turn on the radio by switching on the RADIO circuit breaker on the forward electrical panel of the starboard cockpit console. [For location of cockpit controls of the aircraft radio equipment see figure 29 on the next page.] The set is ready for operation after a 1.5-2-minute delay from the moment the power is turned on.

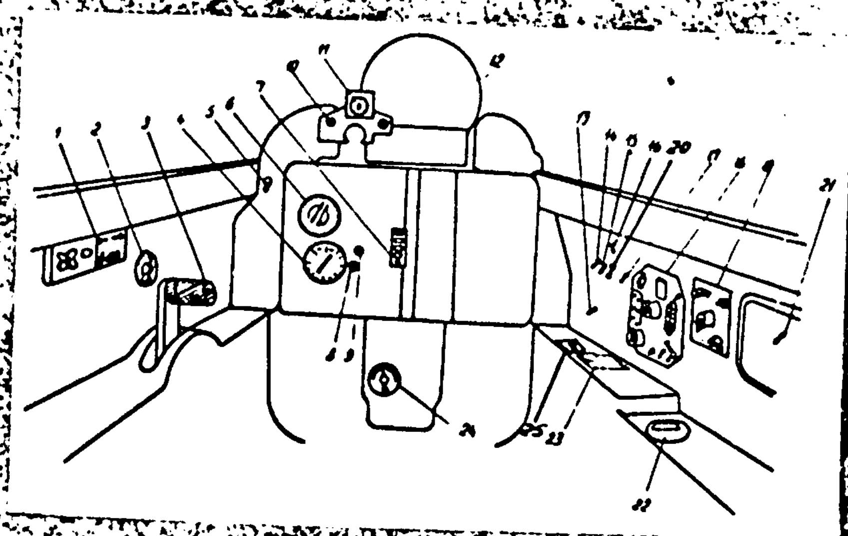


Fig. 29 Location of cockpit controls of the aircraft radio equipment.

Фиг. 29. Схема размещения в кабине приборов контроля и управления радиотехнического оборудования.

[p 114] Captions to Numbers on Fig. 29 on the Preceding Page Showing the Location of Cockpit Controls of the Aircraft Radio Equipment

1. RSIU-5G radio control panel.
2. ARK-10 radio compass REMOTE FREQUENCY SELECTOR switch.
3. RSIU-5G radio TRANSMITTING MODE ON button.
4. UV-57 altitude indicator of the RV-UM radio altimeter.
5. SHORT RANGE -- LONG RANGE switch (ARK-10).
6. UGR-4U course indicator (of the KSI unit).
7. T-4 signal panel.
8. RV-UM radio altimeter DANGEROUS ALTITUDE signal lamp.
9. ARK-BPRS signal lamp.
10. Range only radar DISENGAGE signal lamp.
11. UD-1 range indicator of the range only radar.
12. Range only radar EFFECTIVE RANGE lamp.
13. SRD circuit breaker.
14. MARKER RV-U circuit breaker.
15. RADIO SET circuit breaker.
16. Circuit breaker marked "Upon Failure of the PO-750, RV-U, and MRP".
17. CONVERTER EMERGENCY SWITCH circuit breaker.
18. ARK-10 radio compass control panel.
19. SRO-1 responder radar control panel.
20. SRO circuit breaker.
21. ARK circuit breaker.
22. ARK-10 radio compass tuning indicator.

23. DETONATE button (SRO-1).

24. RSV-UM DANGEROUS ALTITUDE switch of the RV-UM 25 radio altimeter.

DISTRESS pull switch.

2. Select one of the 20 pretuned communication channels by placing the CHANNEL switch located on the P-1 control panel (See figure 30) in the position of the desired channel. (The number of the selected channel will appear in a small window on the cover of the control panel.)

3. Switch the radio from the receiving mode to the transmitting mode by pressing the TRANSMITTER ON button mounted on the engine throttle handle (gas sector); no more than 0.5 second is required for switching from the receiving to the transmitting modes and the other way around.

Supplementary Operations

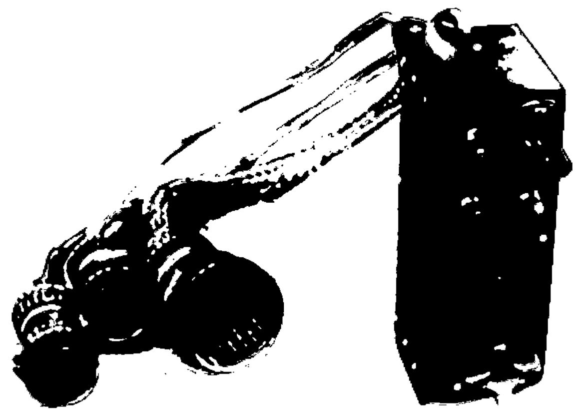
1. Volume is adjusted by rotating the VOLUME control located on the P-1 control panel.

2. The NOISE SUPPRESSOR is switched on or off by manipulating the NOISE SUPPRESSOR switch on the P-1 control panel either to the NOISE SUPPRESSOR or to the OFF positions.

3. Transmitter output is varied by moving the OUTPUT POWER SELECTOR switch on the P-1 control panel to the FULL POWER or REDUCED positions.

4. The outlet of the ARK-10 automatic radio compass may be series connected with the outlet of the RSIU-5G communication radio to the head-
[p 117] set so that both may be used simultaneously by moving the RADIO-COMPASS switch located on the control panel to the COMPASS position.

Warning: Because on some frequencies of the RSIU-5G radio there is interference from the RV-UM set, it is advisable to activate the noise suppressor on the radio control panel, bearing in mind that this reduces the range of radio communications by



Фиг.30. Пульт управления радиостанции РСИУ-5Г

Fig. 30 Control panel of the RSIU-5G radio set

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about 30 percent. In case there is no need to operate the RV-UM set, it should be turned off; keeping in mind, however, that it takes 1-1.5 minutes for the RV-UM radio altimeter to become operational after it has been turned on.

[p 118] Initial Check and Tuning of the Radio Set on the Aircraft

The initial chack and tuning of the radio set is performed with the aid of the I Meter and the N Tuner.

Initial Tuning of the Radio Set

Initial tuning of the radio to the 20 preselected channels consists of tuning the memory unit on the control panel. Selection of the required combination of channels is done with the help of a table printed on a small plate attached to the memory unit. On the unit housing opposite the bent shaft rotary switches, the numbers 1, 2, 3, and 6 are printed to identify the switches.

There are three groups of these switches, each group is marked HUNDREDS, TENS, or UNITS; each group also has two more bent shaft rotary switches identified as OS and S, which are not used in this radio set, and, therefore, should always be left in the DOWN position.

To pretune the memory unit, it is necessary to:

1. Unfasten the memory unit and remove it from the radio control panel.

2. Select the desired frequencies on all 20 channels as follows:

a) Set the desired channel on the memory unit. When tuning, [p 119] the channel number is not read from the flat (disc) dial, the figures of which are visible through a small window in the front panel, but from the narrow cylindrical dial visible at the end of the housing groove.

b) Select the desired frequency on the memory unit with the help of a special key (supplied with the "IN" components and with the "ZIP" of radio sets). Frequency selection is accomplished by turning the switches toward the figures indicating hundreds, tens and units. The bent back end of the shaft of each switch slides along the inclined surface of a plate and is fixed in one of two positions, either UP (shaft raised) or DOWN (shaft lowered). Shafts of switches with the numbers of the frequency to be selected should be raised, all others should be lowered.

The following steps are required to select frequencies for the radio: TENS of megacycles should be chosen from the group of switches marked HUNDREDS; UNITS of megacycles should be selected from the group marked TENS; and TENTHS of megacycles should be chosen from the group marked UNITS (HUNDREDS of megacycles are not selected because the frequency range lies within one hundred, and all frequencies start with the digit 1).

Example: On one of the channels, it is necessary to set a frequency of 146.8 MC.

The digit 4 (tens of megacycles) is selected with switches 1 and 3 in the group of switches marked HUNDREDS.

The digit 6 (units of megacycles) is selected with switch 6 in the group marked TENS.

[p 120] The digit 8 (tenths of megacycles) is selected with switches

2 and 6 in the group marked UNITS.

To select the cipher 0, place all switches for the particular group in the DOWN position.

3. Check the accuracy of frequency selection as follows:

a) Insert the memory unit into the N unit and turn the setscrew to the CLOSED position.

b) Connect the tuning unit by cable to the monitor connection of the transceiver and set the switch on the N unit on the FREQUENCY SELECTION CHECK position.

c) Connect the ground power supply to the aircraft power circuit and turn on the switch marked AIRCRAFT BATTERY, AIRFIELD located on the electric panel of the starboard cockpit console.

d) Switch on the circuit breaker marked RADIO OIL MANOMETER located on the electric panel of the starboard cockpit console.

e) Upon sequential switching of channel numbers on the memory unit, it is possible to verify the accuracy of frequency selection on the signal lamp panel. If the selection is accurate, the sum total of the numbers of the lamps that light on the signal panel will be equal to the value of the digits indicating hundreds, tens, and units of the frequency selected for the given channel. [Comment: The source document is evidently in error here. Since hundreds of megacycles ARE NOT selected and are, obviously, preset, and since tenths ARE selected, provisions should be present to check the correct selection of tenths. On this premise, it is reasonable to assume that the last half of the sentence in the source immediately preceding the present comment should read: "...equal to the value of the digits indicating tens, units, and tenths of the frequency selected for the given channel." There is no necessity to check out the first digit indicating one hundred megacycles since it does not vary and is preset.]

To check the continuity of those contacts opposite which the switches have not been activated (have remained in the DOWN position), place the switch in the LOWER CONTACT CHECK position, whereupon the signal lamps indicating the selected frequencies will be extinguished and all of the remaining signal lamps will light.

[p 121] A check is made of all channels, which are selected in order with the knob of the memory unit.

Note: a) Accuracy of tuning may be checked with the N Tuner without connecting it to the radio set; however, to do this, it is necessary to supply -27 volts to the BS terminals.

b) If the N Tuner with the memory unit inserted into it is connected to the radio set with the switches in the LOWER CONTACT CHECK position, all pulse servo motors in the set will turn incessantly, which may damage them.

c) If, when checking the selection of frequencies, the frequency is selected on the control panel, then the memory unit must be removed from the N Tuner (and vice versa); otherwise, the DOCh [Distantsionnoye Opredeleniye Chastoty, remote frequency selection] pulse servo motors will turn

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constantly and may be damaged.

4. Turn off the radio set and disconnect the airfield power source from the aircraft power circuit.

5. Disconnect the N Tuner from the transceiver.

6. Turn the setscrew to the OPEN position and remove the memory unit from the N Tuner.

7. Reinsert the memory unit into the radio control panel and turn the setscrew to the CLOSED position.

[p 122] <u>Monitoring the Power Supply Circuit of the Radio Set</u>

The power supply circuit of the radio set is monitored with the help of the I Meter which performs a number of metering functions.

To measure the check voltages of the radio set proceed as follows:

1. Connect the I Meter (connection Sh12-1) to the transceiver monitor connection (Sh10-1).

2. Connect the ground power source to the aircraft power circuit and turn on the radio set.

3. Meter the check voltages by placing the MEASUREMENT selector in the following positions:

a) AIRCRAFT CIRCUIT VOLTAGE $\pm$27 v

b) FILAMENT VOLTAGE ~ 6.3 v

c) PLATE VOLTAGE +125 v and 250 v

d) GRID BIAS —105 v

Tolerances for items b, c, and d, is +7 percent.

4. In the receiving mode, check the transceiver current drain in

the 125-volt plate circuit; in the transmitting mode, check the transceiver current drain in the 250-volt plate circuit. In both cases, the needle should be in the black sector of the dial.

[p 123] In the transmitting mode check:

-- the output stage grid voltage for 180-220 v.

-- the output stage grid bias for a reading of 30-100 on the meter.

In the ANTENNA CURRENT position, check for the presence of r-f in the antenna; the meter should read at least 20.

5. Check the operation of the AFC (APCh, Avtomaticheskaya Podstroyka Chastoty; AFC, Automatic Frequency Control) circuit as follows:

a) In the receiving mode, place the MEASUREMENT control in the AFC RCVR position and on the control panel select each frequency channel of the radio set in order. If the AFC circuit is operating normally, the meter should read 15-35.

b) In the transmitting mode, place the MEASUREMENT control in the AFC TRANSMITTER position. If the AFC transmitter circuit is operating normally, the meter should read 14-35.

Operational Check of the Radio Set

The operational capability check of the radio set is performed as follows:

1. Connect the ground power source to the aircraft power circuit.

[p 124] 2. Connect the helmet headset or the pressurized helmet to the coupler in the cockpit. It is essential to keep in mind that the operation of the radio set may be checked with the selector switch on the UK-2M amplifier in various positions (See figure 31).

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50X1-HUM

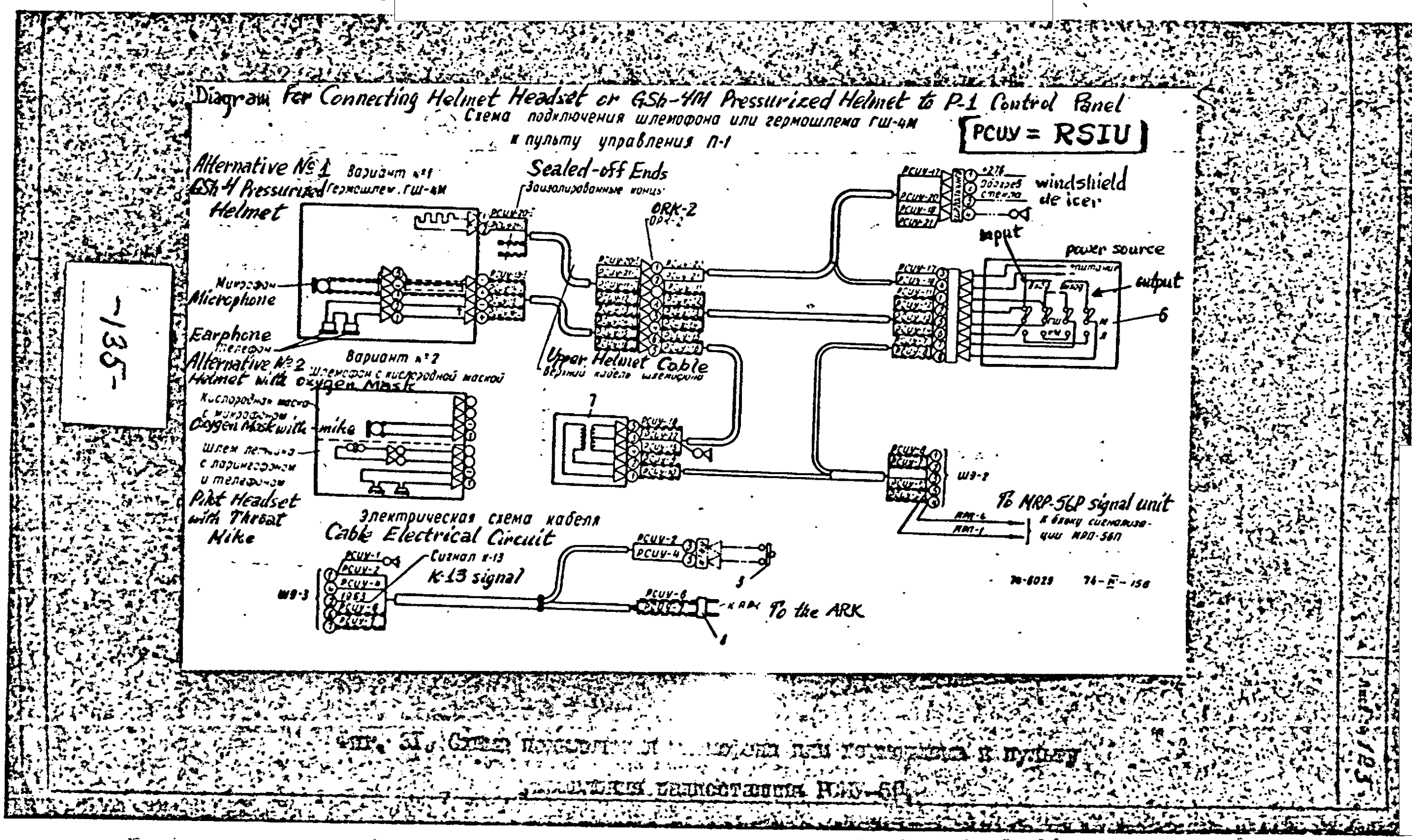


Fig 31 Diagram for connecting the helmet headset or the pressurized helmet to the RSIU-5G radio control panel

50X1-HUM

SECRET

50X1-HUM

[p 126] Captions to Numbers on Figure 31 on the Preceding Page Showing the Diagram for Connecting the Helmet Headset or the Pressurized Helmet to the RSIU-5G Radio Control Panel

3. RSIU-5G radio transmitting mode ON button

6. UK-2M amplifier

7. Decoupling transformer

8. Two-pin plug with set screws

When checking the radio with the pressure helmet on, the amplifier switches should be in the GSh and M positions.

When checking the radio with the helmet headset on, the amplifier switches should be in the KM and L positions.

3. Use the knob on the control panel to set one of the preselected channels.

4. Turn on the AIRCRAFT BATTERY, AIRFIELD switch located on the electrical panel in the starboard console of the cockpit and the RADIO OIL MANOMETER circuit breaker; warm up the radio set for about 1.5-2 minutes.

5. Locate the NOISE SUPPRESSOR control in the OFF position and the VOLUME control at maximum, check the operation of the radio in the receiving mode for noise and for reception of an operating station.

When the NOISE SUPPRESSOR is on, no noise should be heard in the earphones.

[p 127] In the transmitting mode at nominal and low power, check the operation of the radio on all channels by monitoring and by communicating with the airfield radio station or with another aircraft.

While testing the operational capability of the radio set in both the receiving and transmitting modes, also check the operation of controls.

After completing the operational check, turn off the RADIO OIL MANOMETER circuit breaker and the AIRCRAFT BATTERY, AIRFIELD switch and disconnect the airfield power supply.

[p 128]

Chapter II

The ARK-10 Automatic Radio Compass

1. General Information

The ARK-10 medium-wave band automatic compass is designed for guiding the aircraft by either homing or broadcast radio or by radio beacon and provides constant determination of the course angle and the solution of the following navigational problems:

1. Flight toward the radio station or away from it with visual indication of course angle.

2. Automatic determination of radio station bearing on a course indicator.

3. Instrument landing by means of a simplified blind landing system.

4. Reception of audible signals from medium-wave band radio stations within a frequency band spread of 120-1340 kilocycles.

The ARK-10 medium-wave band automatic radio compass is designed to operate in three modes:

Mode 1 -- the automatic direction-finding COMPASS mode. In this mode, as the radio compass is tuned to the frequency of a direction-indicating station, the course angle to the station is automatically set on the UGR-4 course indicator.

Mode 2 -- the audio direction-finding LOOP mode. In this mode, as the instrument is tuned to the frequency of a direction-indicating radio station, the loop antenna is rotated (by means of the manual-turn switch marked LOOP L -- P) while listening to the signal or while observing

the strength of the signal on the tuning indicator; the direction of the
[p 131] loop antenna is then determined in relation to minimum (or zero) reception. Either the course angle, or an angle of 180° from the course angle, is set on the UGR-4 course indicator.

Mode 3 -- the ANTENNA mode of operation. In this mode, the radio compass functions as an ordinary medium wave-band communication receiver with considerably high sensitivity and interference rejection.

The ARK-10 radio compass set installed in aircraft consists of the following components (See figure 32):

1. Receiver
2. Power supply
3. Control panel
4. REMOTE FREQUENCY SELECTOR switch (PVD)
5. UGR-4U course indicator (of the KSI set)
6. TUNING indicator
7. SHORT RANGE -- LONG RANGE switch
8. UAP-1 multipurpose automatic switch
9. Antenna amplifier
10. Directional antenna unit (loop)
11. Common (non-directional) rod antenna of the RSIU-5 and ARK-10 radios
12. AF-1 filter for the common rod antenna
13. Five-meter feeder equivalent in the channel of the directional antenna (two)

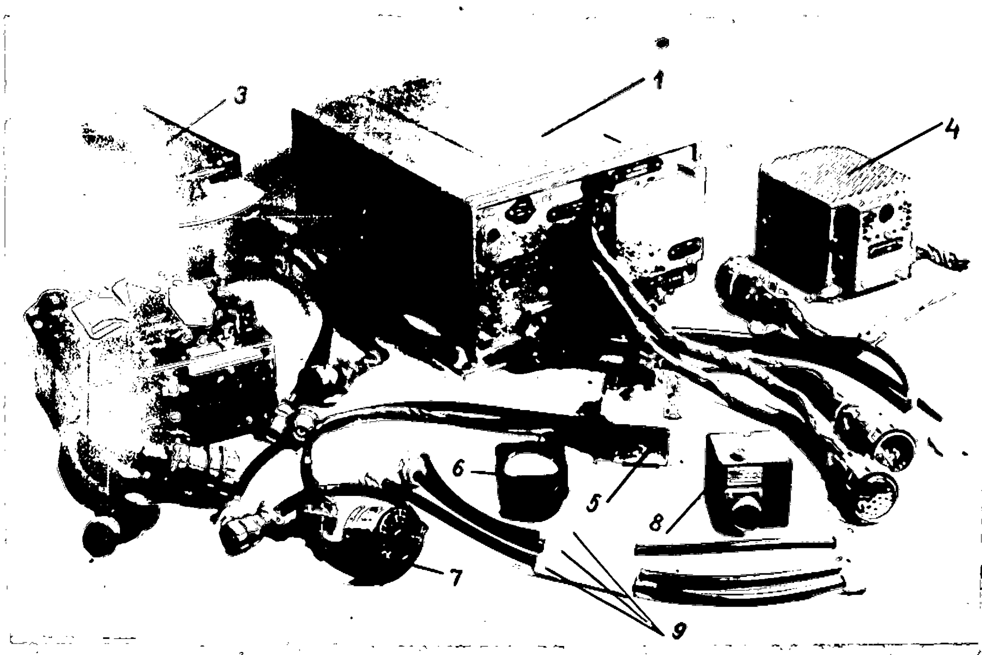
14. Fifteen-meter feeder equivalent in the channel of the common rod antenna

15. Three-meter feeder equivalent in the channel of the common rod antenna

16. ARK-BPRS [BPRS, Blizhnyaya Privodnaya Radio Stantsiya; Inner Marker Beacon] signal lamp

17. Set of leads and cables.

50X1-HUM



Фиг.32. Комплект радиокомпаса АРК-10

Fig. 32. The ARK-10 Radio Compass Set

50X1-HUM

648

[p 130] Captions to Numbers on Fig. 32 on the Preceding Page Showing the ARK-10 Radio Compass Set

1. Receiver
2. Control panel
3. Loop antenna
4. Power supply
5. Antenna amplifier
6. Tuning indicator
7. REMOTE FREQUENCY SELECTOR switch (PVD)
8. UAP-1 multipurpose automatic switch
9. Feeder equivalents (3 m, 5 m, 15 m)

[p 132]

2. Location of the Radio Compass Components in the Aircraft

Components of the radio compass are located in the aircraft as follows (See figure 33):

1. Receiver -- in the upper part of the equipment bay, between frames 5 and 6.

2. Power supply -- in the upper part of the equipment bay, to the right between frames 3 and 4 (closer to frame 4).

3. Control panel -- on the vertical panel of the starboard cockpit console.

4. REMOTE FREQUENCY SELECTOR switch (PVD) -- on the vertical part of the port cockpit console.

5. UGR-4U course indicator -- on the movable port section of the cockpit instrument panel.

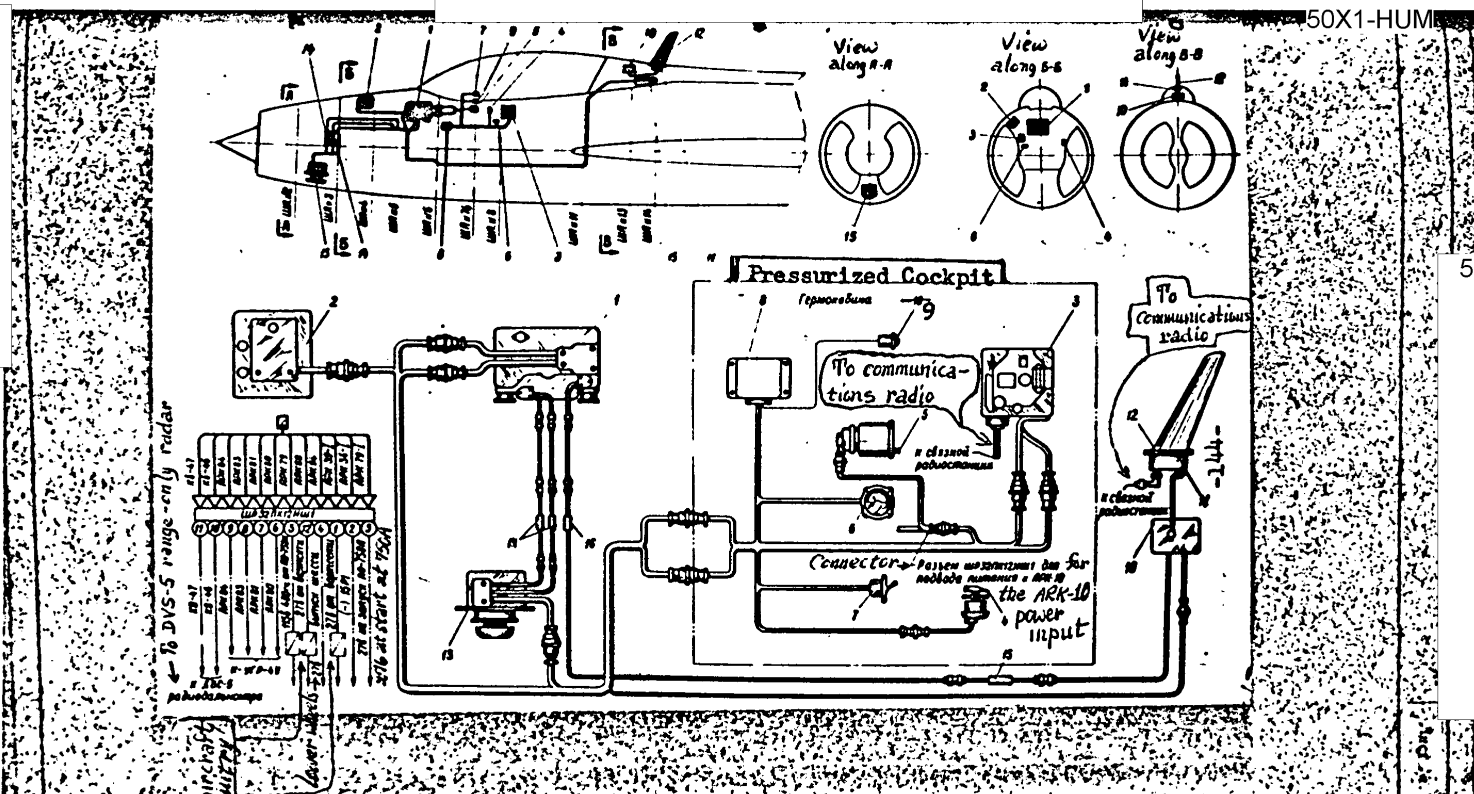
6. Tuning indicator -- on the horizontal part of the starboard cockpit control console.

7. SHORT RANGE -- LONG RANGE switch -- on the port stationary panel of the cockpit instrument console.

8. UAP-1 multipurpose automatic switch -- at the instrument panel on the starboard side between frames 6 and 7.

9. Antenna amplifier -- on the rear stationary section of the canopy (in the area of frame 13).

10. Loop antenna -- in the lower portion of the nose section of the fuselage between frames 2 and 3 in a special compartment along the axis of symmetry.



Фиг. 33. Схема соединения и размещения на самолете блоков радиокомпаса АРК-10.

Fig. 33. Interconnection and Location Diagram for the ARK-10 Radio Compass Components

[p 134] Captions to Numbers on Fig. 33 on the Preceding Page Showing the Interconnection and Location Diagram for the ARK-10 Radio Compass Components

1. Receiver
2. Power supply
3. Control panel
4. REMOTE FREQUENCY SELECTOR switch (PVD)
5. UGR-4U course indicator (of the KSI set)
6. Tuning indicator
7. SHORT RANGE -- LONG RANGE switch
8. UAP-1 multipurpose automatic switch

[Note: In the source document, the typist inadvertently jumped here from 8 to 10. Lack of correspondence of the numbered captions to the numbers on figure 33 confirm the error. The necessary correction has been made in the English version.]

9. ARK-BPRS signal lamp
10. Antenna amplifier
11. AF-1 antenna filter (separation)
12. Common rod antenna of the RSIU-5G and ARK-10 radios
13. Directional (loop) antenna unit
14. 5-meter feeder equivalent in the directional antenna channel

15-16. 15-meter and 3-meter feeder equivalents in the common rod antenna channel

17K-26K. Set of wire harnesses and feeder cables [not indicated].

[p 135] 11. Common rod antenna -- on the rear stationary section of the canopy.

12. AF-1 antenna filter -- fastened to the lower end of the common rod antenna.

13. ARK-BPRS signal lamp -- on the cockpit instrument console.

3. Radio Compass Servicing and Maintenance

Precautionary Measures

When tuning, inspecting, repairing, and trouble-shooting the radio compass, bear in mind that:

1. When the locators are uncovered, the automatic tuning buttons (1-9) must not be pressed.

2. The COARSE TUNING CONTROL must be pulled out as far as it will go before it is used for continuous frequency tuning.

3. If the automatic tuning mechanism begins to whirl without stopping after one of the numbered (1-9) buttons has been pushed, another button must be pushed to stop the mechanism, after which the desired button may be pushed again.

4. The radio compass must not be operated unless one of the numbered (1-10) buttons on the panel is in a depressed position.

5. The tuning dial may be disturbed when switching sub-bands during
[p 136] continuous tuning; therefore, select the desired wave band on the tuning dial first, and then tune in the frequency.

6. When checking the operation of the UAP-1 on the ground and when the ambient temperature is more than 50° Centigrade, do not leave the BPRS

in the TUNING MODE for more than 2 minutes.

7. If the control panel becomes accidently inoperative, the P button cannot be used; continuous tuning may be accomplished by depressing any of the fixed-position buttons. In this case, the WAVE BAND SET and the COARSE TUNING controls must be disengaged.

Radio Compass Operating Procedure

The radio compass is operated from the control panel (See figure 34). To operate the compass proceed as follows:

1. Turn on the ARK circuit breaker located on the rear electrical panel of the cockpit control console; then, turn on the radio compass by rotating the MODE SELECTOR switch from the OFF position to one of the three positions -- COMPASS, ANTENNA, or LOOP.

2. Tune the receiver to the desired frequency of the operating wave band by first pressing the P button and then locate the WAVE BAND SELECTOR, COARSE TUNING, and CONTINUOUS TUNING controls in their proper positions.

3. To tune the receiver to fixed frequencies, depress the button designating the desired pretuned frequency.

[p 138] 4. To change the passband, place the BROAD - NARROW passband selector switch in the desired position.

5. To change from the PHONE to the TELEGRAPH modes of operation, locate the TLF-TLG switch in the appropriate position.

6. To regulate receiver gain in the ANTENNA and LOOP modes and to adjust earphone signal volume in the COMPASS mode of operation, use the knob labeled VOLUME CONTROL.

7. To rotate the directional antenna in either direction in the LOOP mode, depress the LOOP L-P (Levo-Pravo; Left-Right) switch.

For convenience of operation and, particularly, to accelerate fixed-frequency tuning, and at the same time to provide selection of long-range homing station or a short-range one, a REMOTE FREQUENCY SELECTOR switch (PVD) is supplied with the radio compass (See figure 35). The even-numbered buttons on the control console select short-range radio stations and are connected to the REMOTE FREQUENCY SELECTOR switch.

During landing approach, the AUP-1 multipurpose automatic switch is used to switch from long-range homing radio to short-range approach radio. However, manual tuning of the radio compass is still possible with the SHORT RANGE -- LONG RANGE switch on the aircraft.

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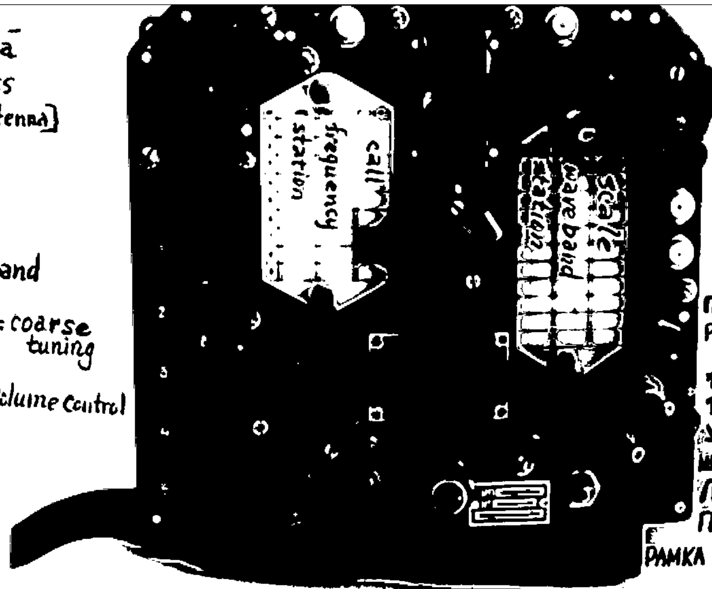

Fig. 34 ARK-10 Radio Compass control panel

фиг.34 Пульт управления радиокомпаса АРК-10

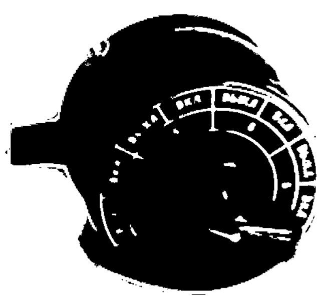

Fig. 35 ARK-10 Radio Compass frequency selector switch (PVD)

фиг. 35 Переключатель волн дистанционный /ПВД/ радиокомпаса АРК-10

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Declassified in Part - Sanitized Copy Approved for Release 2013/01/25 : CIA-RDP80T00246A030900040001-4

[p 139] Preliminary Check and Tuning of the Radio Compass

1. Setting the Fixed Frequencies on the Ground

a) Connect the aircraft power circuit to the ground power source (direct and alternating current).

b) Turn on the AIRCRAFT BATTERY, AIRFIELD switch, located on the vertical part of the starboard cockpit control console, and the ARK circuit breaker located on the starboard console electrical panel.

c) Place the mode switch in the ANTENNA position and the TLF-TLG switch in the TLF position.

d) Depress the selected button.

e) After the mechanism has completed its cycle, release the WAVE-BAND switch and set the sub-band to correspond to the selected frequency. Lock the WAVE-BAND switch knob.

f) Unlock the COARSE TUNING knob and set the dial to the desired frequency.

Fine tuning on a given mark on the dial is performed with the aid of the CONTINUOUS TUNING knob, which first must be moved to the stop, then carefully turned from side to side, and adjusted for maximum declination of the tuning indicator needle. Listen for the radio station call signals.

[p 140] Fine tuning with the CONTINUOUS TUNING knob is done initially over a broad band and then over the narrow band (then return again to the broad band).

During fine tuning, adjust receiver gain with the VOLUME CONTROL knob so that the indicator needle stops in the center of the dial. Following completion of tuning, reset the locking device on the COARSE TUNING knob.

Essentially the same procedure should be employed to tune the radio to assigned frequencies of long-range and short-range homing radio stations on the remaining fixed-frequency tuning buttons and to fill out the fixed-frequency-button table on the radio compass control panel. When tuning to fixed frequencies, remember that the even-numbered buttons (2, 4, 6, and 8) are used to set short-range radio station frequencies, and that the odd-numbered buttons (1, 3, 5, 7, and 9) are used to set frequencies of long-range radio stations. A short-range station and its counterpart long-range station occupy consecutive numbers.

Bear in mind also that each even-numbered button corresponds to two positions, I and II, on the REMOTE FREQUENCY SELECTOR switch, and that the selector is set according to the frequencies of the short-range and long-range homing radio stations. In the event that the (dial) frequency of the short-range approach radio station is less than the frequency of the long-range station, then the PVD [FREQUENCY SELECTOR] switch must be placed in the I position. Should the (dial) frequency of the short-range approach station be greater than the frequency of the long-range station, then the PVD switch must be placed in the II position. However, should the frequency of the short-range approach radio station exceed that of the long-range station by 80 or more kilocycles, then the switch should be placed in the I position.

[p 141] 2. Fixed Frequency Tuning on the ARK-10

Depress a button to select the desired fixed frequency. No further tuning of the radio compass is necessary when receiving a homing station operating on a stabilized frequency.

Should tuning become necessary, the COARSE TUNING control must be unlocked, and the CONTINUOUS TUNING control should be adjusted for maximum reading of the tuning indicator needle.

3. Continuous Tuning on the Radio Compass

a) Press the CONTINUOUS TUNING button (identified with the letter P [Plavnaya; Continuous]).

b) Place the MODE switch on the control panel in the ANTENNA position and the TLF-TLG switch in the TLF position.

c) Select the desired sub-band with the WAVE BAND SET knob.

d) Set the COARSE TUNING control so that the dial reading corresponds approximately to the station frequency.

e) Depress the CONTINUOUS TUNING control as far as it will go and use it to set the control panel dial exactly on the precise frequency of the station. If the station is stable, further tuning will not be required. Listen for the call signal of the homing radio station.

f) If the station is not sufficiently stable, carry out fine tuning with the CONTINUOUS TUNING knob by turning it in both directions for 3-4 kc, until a maximum reading to the right on the tuning dial is achieved. The VOLUME CONTROL knob on the control panel should then be used to bring

the indicator needle back to the center of the dial. Resume fine tun-
[p 142] ing. It should be noted that the tuning is performed with the use of the tuning indicator and with the BROAD - NARROW switch on the control panel in the BROAD position; however, it is then necessary to switch back to the narrow band and to tune once more.

Operation is normally over the broad band. The narrow band is recommended to be used when interference is encountered from atmospheric disturbances or from stations operating on adjacent frequencies.

After completing tuning in the ANTENNA mode, switch to the COMPASS mode and bring in a radio station to check the direction-finding accuracy of the course indicator. This is done by turning the pointer of the L - P [LEFT - RIGHT] switch 100-160 degrees in either direction, and then checking its return to the proper bearing.

<u>Note</u>: Should the signal of a strong broadcasting station be heard in the earphones while tuning the radio compass to a homing station, this could be caused by the formation of combined frequencies in the antenna amplifier. Combined frequencies are formed whenever the frequency of the homing station is the same as the beat frequency of two strong interfering stations; these interferences, however, are heard only through the earphone jack and do not affect bearing indication accuracy.

Should the interference be so strong so as to prevent the homing radio call signals from being heard, the radio compass must be removed from the plane in order to check the combined [p 143] interference attenuation in the receiver channel. Frequencies of 300, 600, 900, and 1,200 kc constitute interference points in the radio compass. Various whistles may be heard at these frequencies. This reduces homing sensitivity to one half to one sixth of the normal level.

Operational Check of the Radio Compass

1. Connect the airfield power source to the aircraft power circuit.

2. Turn on the AIRCRAFT BATTERY, AIRFIELD switch located on the vertical section of the starboard cockpit control console and the ARK circuit breaker located on the rear electrical panel of the starboard control console.

3. Turn on the MODE switch to the COMPASS, ANTENNA, and LOOP positions, anke make sure that the radio compass is on by checking to see that the panel illumination light is lit. Check tuning indicator needle declination and the presence of noise in the earphones (the VOLUME CONTROL should be rotated clockwise as far as it will go).

4. Place the MODE switch in the ANTENNA position, tune the receiver to any radio station in this band and listen to its call signal.

[p 144] 5. Locate the MODE switch in the COMPASS position. The UGR-4U indicator should then point in the direction of the radio station.

6 Make sure that the SUB-BAND switch is operating by listening for noise in the earphones.

7. Make sure that the TLF-TLG switch is working by listening for an audible tone (one kc) in the earphones when switched to the TLG mode and for the disappearance of the tone while switched to the TLF mode.

8. Manipulate the VOLUME CONTROL knob located on the control panel and make sure that the regulator is operating when the MODE switch is in the COMPASS, ANTENNA, and LOOP positions.

9. Ascertain the formation of broad and narrow bands when using the BROAD - NARROW switch. Both timbre and volume should change in the earphones when switching from one band to the other.

10. Make sure that the electromagnetic brake on the CONTINUOUS TUNING control is working by depressing the tuning knob as far as it will go and by observing if it remains in that position.

11. Depress the L-P switch on the control panel and make sure that the loop antenna can be turned manually in the ANTENNA, LOOP, and COMPASS modes. The loop should turn faster in the COMPASS mode than in the other two modes.

12. In the COMPASS mode, swing the loop antenna 100-160° away from the homing bearing and check if the indicator needle returns to the proper bearing. Repeat this process several times, moving the loop antenna first to the right and then to the left away from the correct bearing.

[p 145] 13. Tune in a broadcast station and check the radio compass tuning dial graduation as follows:

a) Place the MODE switch on the control panel in the ANTENNA or LOOP positions:

b) Depress the P CONTINUOUS TUNING button.

c) With the COARSE TUNING knob select on the dial a frequency corresponding to that of the broadcasting station being used for the test.

d) Set the BROAD - NARROW knob in the NARROW position and adjust the CONTINUOUS TUNING knob for maximum declination of the tuning indicator needle.

The difference between the dial frequency reading (which corresponds to fine tuning) and the actual frequency of the station signal being received will indicate the accuracy of the tuning dial. Dial error must not exceed 200-800 kc, i.e., one half of a small graduation mark on the dial.

14. Determine the approximate range of operation. This can be accomplished by tuning in the COMPASS mode to several stations located at least 100-200 km from the aircraft. Station bearings should be indicated and the station call signals should be audible.

15. Check the radio compass tuning cycle time. This requires that the control panel button 1 be used to set a frequency of 540 kc on sub-band III (on the 120 dial). Button 2 should be used to set a frequency of
[p 146] 245-250 kc on sub-band I (shown on the 125-130 dial); either an operational station must be located at this frequency, or the frequency must be obtained from the IRK-2 test instrument.

Before beginning the measurement, button 1 should be depressed (setting the frequency at the beginning of sub-band III). The tuning interval is measured on the second counter from the instant button 2 is depressed to the instant the course indicator needle comes to rest in the bearing position of the radio station [Note: In the source document, two-thirds of a line is blacked out here; the rest of the sentence reads as follows:] and to the declination of the tuning indicator needle.

16. Place the SHORT RANGE -- LONG RANGE switch first in the SHORT RANGE position and then in the LONG RANGE position and check the tuning dial at each of these positions to make sure that the radio compass is tuning to frequencies corresponding to short-range and long-range homing stations. After completing the check, place the switch in the LONG RANGE position.

17. Check the operation of the UAP-1 switching device as follows:

a) Place the MODE switch on the control panel in the LOOP position.

b) With the L-P switch position the loop antenna so that the UGR-4U indicator reads 0 $\pm 20^{\circ}$.

c) Engage the odd-numbered button which sets the frequency of a long-range airfield homing radio station and engage the even-numbered

[p 147] buttons (short-range approach radio station). During this operation, the SHORT RANGE -- LONG RANGE switch must be in the LONG RANGE position, and the remote sub-band switch (PVD) should be placed in the I position.

d) Place the LANDING GEAR LIMIT switch in the WHEELS UP position. Use the buzzer to check the operation of the MRP receiver by the illumination of the signal lamp on the instrument panel (the T-4 panel). Then place the landing gear limit switch in the WHEELS DOWN position.

This should cause the radio compass to zero-in on the frequency of a short-range approach radio station.

e) Turn off the buzzer and the marker beacon receiver.

f) Use the L-P switch to position the loop antenna to the point where the radio compass switches over from the short-range to the long-range homing radio station.

Turn off the radio compass and disconnect the airfield power source from the aircraft power circuit.

[p 148]

Chapter III

The RV-UM Low-Altitude Radio Altimeter

1. General Information

The RV-UM low-altitude radio altimeter is designed for determining the actual altitude of the aircraft over the earth's surface and for signaling the dangerous altitude preset by the pilot.

The Doppler system is used to determine the actual altitude of the aircraft.

Note: Only the radio altimeter is used to measure the actual aircraft altitude of up to 400 meters. At altitudes greater than 400 meters, the barometric altimeter is employed, and the radio altimeter is used for orientation purposes.

When flying at altitudes above 600 meters, to prevent the UV-57 altimeter from giving a false reading, a blocking circuit in the RV-UM radio altimeter transceiver positions the UV-57 altitude indicator needle to the right stop.

A dangerous altitute warning signal is incorporated into the radio altimeter transceiver circuit so as to provide both visual and audio warning to the pilot should the aircraft descend to one of the dangerous altitudes which he had previously selected and set into the instrument.

[p 150] The audio dangerous altitude signal is an intermittent tone of 400 kc of 2-3 seconds duration heard in the pilot's headphones.

The visual signal is the illumination of a red signal lamp on the left movable section of the cockpit instrument panel.

Dangerous altitude warning signals may be provided at altitudes of 50 meter, 100 meter, 150 meters, 200 meters, 300 meters, or 400 meters, depending on the position of the DANGEROUS ALTITUDE switch. When the radio altimeter is put in operation on the ground, both audio and visual signals are activated, and the visual signal remains lighted until the aircraft has exceeded the altitude to which the DANGEROUS ALTITUDE switch has been set.

The following RV-UM radio altimeter components are installed in the aircraft (See figure 36):

1. PP-U transceiver
2. Transmitting antenna
3. Receiving antenna
4. UV-57 altitude indicator
5. Red signal lamp
6. PSV-UM DANGEROUS ALTITUDE switch
7. Set of wire harnesses and feeder cables

2. Location of Radio Altimeter Components on the Aircraft

Components of the RV-UM radio altimeter are installed on the aircraft as follows (See figure 37):

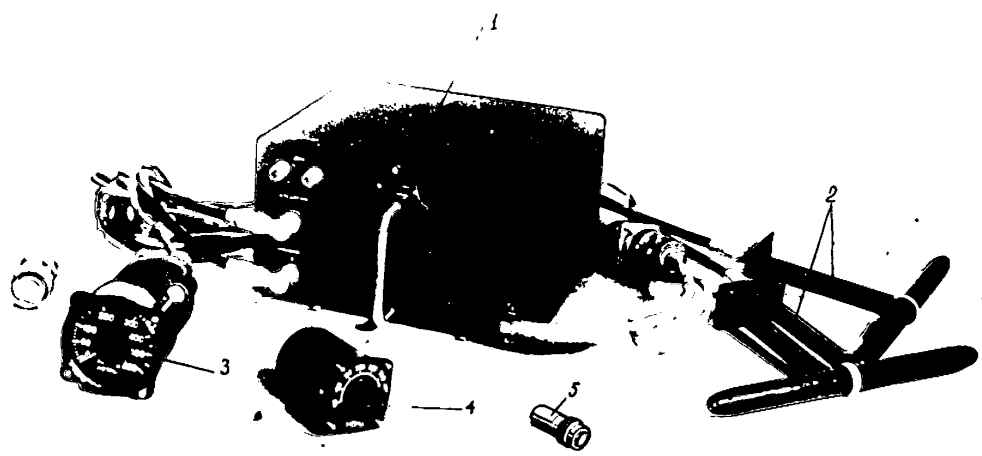
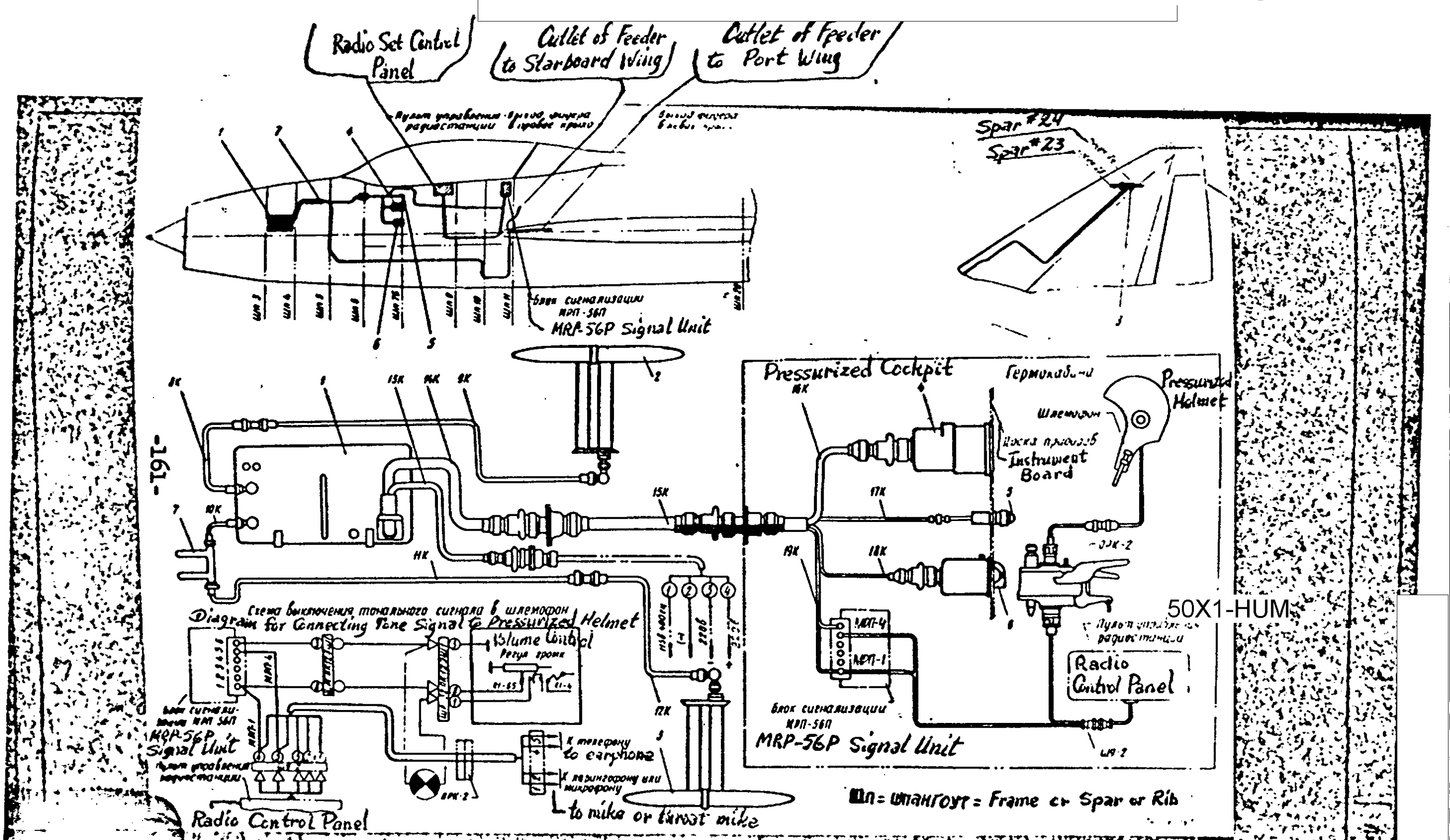


Fig. 36. RV-UM Radio Altimeter Set

36.. [illegible]

[illegible]

1-Transceiver; 2-Transmitting and Receiving Antennas; 3-Altitude Indicator; 4-Dangerous Altitude Switch; 5-Signal Lamp



Фиг. 37. Схема соединения и размещения на самолете блоков радиовысотомера РВ-УМ.

Fig. 37. Location and cabling diagram of the PV-UM Radio Altimeter on the aircraft

[p 152] Captions to Numbers on Fig. 37 Showing the Location and Cabling Diagram of the RV-UM Radio Altimeter Components on the Aircraft

1. Transceiver - PP-U unit
2. Transmitting antenna
3. Receiving antenna
4. UV-57 Altitude indicator
5. Signal lamp
6. PSV-UM DANGEROUS ALTITUDE switch
7. VChF-3 filter

8K-19K. Set of wire harnesses and feeder cables

1. The transceiver is installed in the upper equipment bay between [p 153] frames 3 and 4 with the front panel facing frame 4.

2. The receiving antenna is mounted on the underside of the starboard wing between forward ribs 23 and 24 with its axis parallel to that of the aircraft.

3. The transmitting antenna is placed on the underside of the port wing between forward ribs 23 and 24 with its axis also parallel to that of the aircraft.

4. The UV-57 altitude indicator is located on the port movable section of the cockpit instrument panel.

5. The PSV-UM DANGEROUS ALTITUDE selector switch is on the central portion of the cockpit instrument panel.

6. The DANGEROUS ALTITUDE signal lamp is located on the left movable panel of the cockpit instrument panel.

3. Servicing and Maintenance of the Radio Altimeter

Preliminary Tuning and Testing

Once the preadjusted radio altimeter has been installed in the aircraft, it does not need any further tuning during operation since it is already tuned to a preset frequency. The RV-UM is retuned only in event of repair or component replacement.

[p 154] Calibration

Calibration of the radio altimeter is carried out on the aircraft with the aid of two T-1 Testers in the following sequence:

Connect the radio altimeter to the tester 20-meter equivalent delay line by disconnecting the F-3 lead from the H-1 terminal and replacing it with a connecting cable (See figure 38).

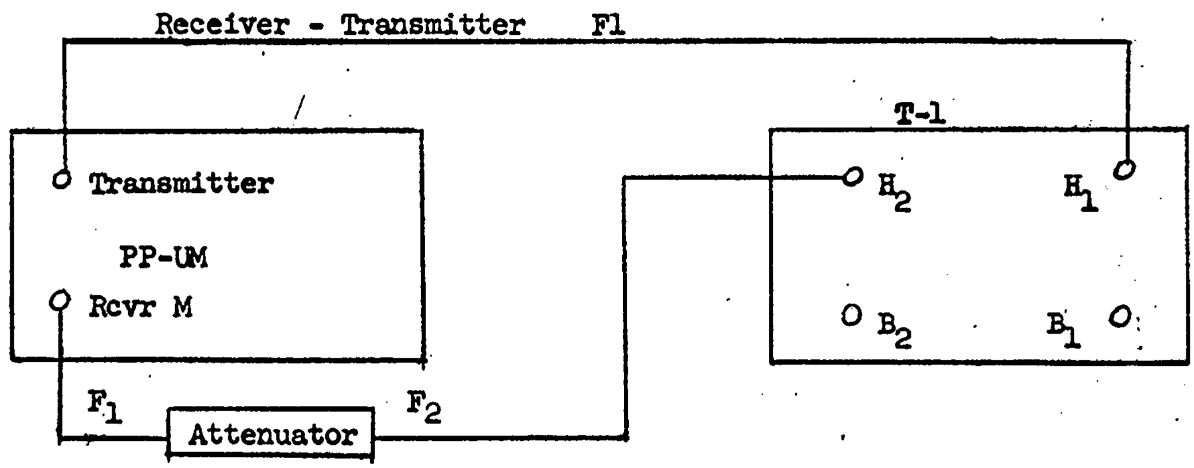


Fig. 38 Connecting diagram for the T-1 Tester 20-meter delay line and the PV-UM Radio Altimeter

With the ZERO SET potentiometer, set the altitude indicator needle at 20 meters $\pm$2 meters minus the residual altitude.

[p 155] 2. Connect two 100-meter delay lines to the radio altimeter and two T-1 testers without an attenuator (See figure 39).

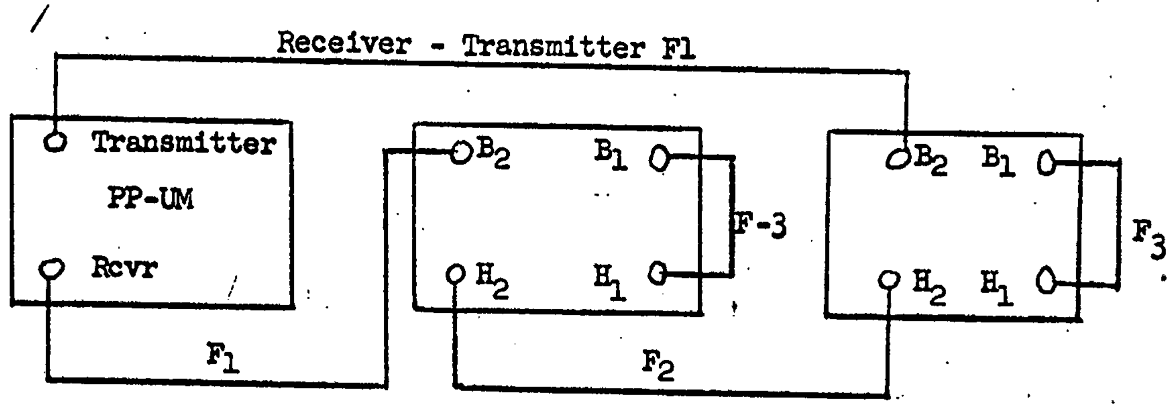


Fig. 39 Connecting diagram for two 100-meter delay line, T-1 testers, and the radio altimeter

With the CALIBRATION potentiometer set the UV-57 altitude indicator to read 200 meters ± 5 meters minus the residual altitude.

3. Check the calibration at the 20-meter mark and, if necessary, correct any error with the ZERO SET potentiometer. Adjust settings at the 20-meter and 200-meter marks until the altitude indicator needle registers within ± 5 meters of these points.

[p 156] 4. Connect the 100-meter delay line to the radio altimeter and the T-1 tester with an attenuator and check the reading of the altitude indicator at the 100-meter mark. The altitude indicator should read 100 meters ± 5 meters minus the residual altitude.

<u>Over-all Sensitivity Check of the Radio Altimeter on the Aircraft</u>

The T-1 tester is used to check the over-all sensitivity of the radio altimeter.

When the T-1 tester is used to determined over-all sensitivity of the radio altimeter, the minimal reflected signal strength value is found at which, when fed to the receiver, the altimeter will give a correct altitude reading. Changes in the reflected signal value are obtained with the help of the attenuator by changing the distance between stationary and movable couplers.

Over-all sensitivity is determined at the 100-meter mark (with allowance for the residual altitude).

Proceed as follows:

1. Connect the T-1 tester 100-meter delay line to the radio altimeter (See figure 40).

[p 157]

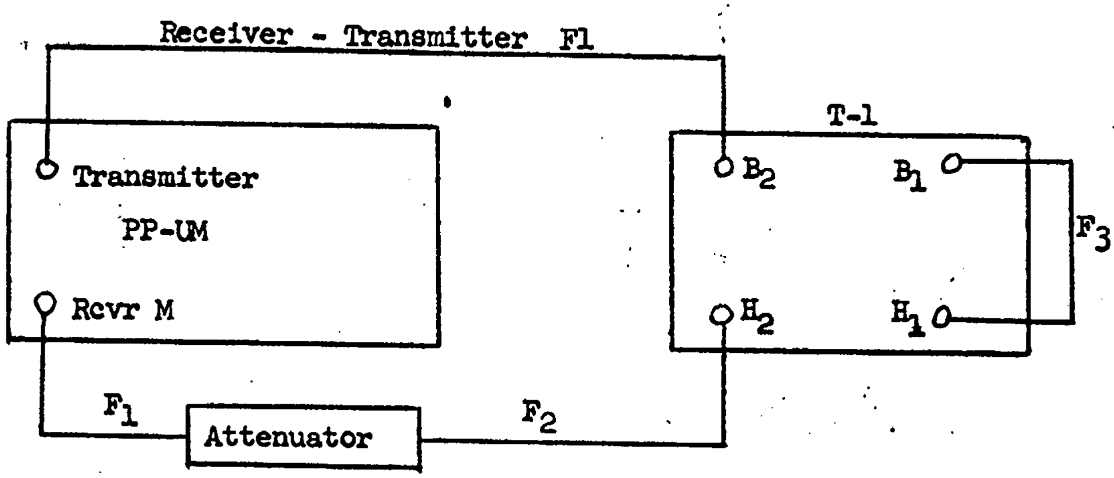


Fig. 40 Connecting diagram for the T-1 100-meter delay line and the RV-UM Radio Altimeter

2. Connect the airfield power source to the aircraft power circuit. Turn on the AIRCRAFT BATTERY, AIRFIELD switch located on the forward electrical panel of the starboard cockpit console, and turn on the MRP-RVU circuit breaker located on the forward electrical panel of the starboard

cockpit console. Preheat the tubes for 3-5 minutes.

3. Slowly withdraw the movable part of the attenuator until the altitude indicator needle falls 10 meters from its original position.

[p 159] 4. Read the attenuator dial. Total attenuation of the T-1 tester delay line and of the attenuator should be no less than 75 decibels.

5. Spread the attenuator to the limit. The needle of the UV-57 altitude should drop below zero (See figure 41).

If the total attenuation of the T-1 tester and the attenuator is less than 76 decibels, or, if the UV-57 altitude indicator needle is above the zero mark, replace the altimeter set.

Note: 1. During the over-all sensitivity check, the PSV-UM DANGEROUS ALTITUDE switch should be in the OFF position (See figure 42).

2. During the over-all sensitivity check, the total attenuation of the T-1 tester and the attenuator should not exceed 67 decibels.

After completing the check, turn off the radio altimeter and disconnect the airfield power source from the aircraft power circuit.

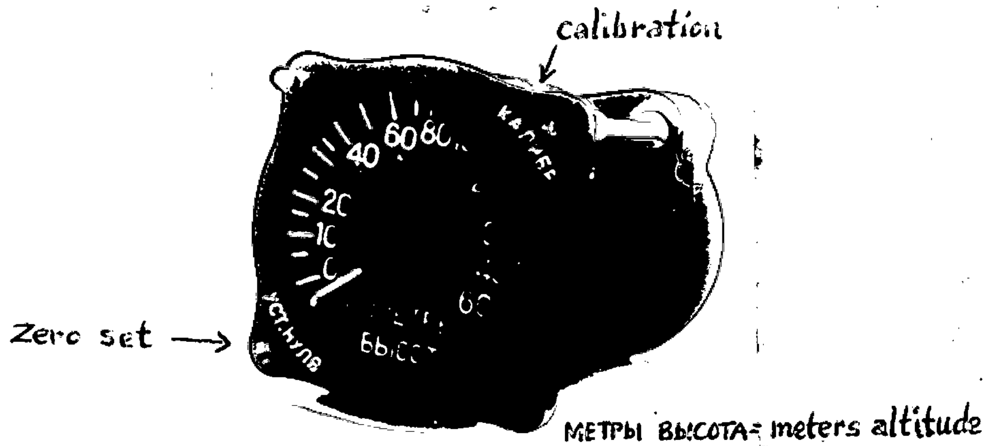
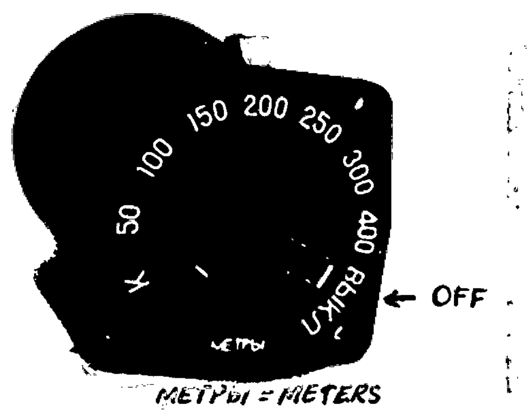


Fig. 41. UV-57 Altitude Indicator of RV-UM Radio Altimeter

Фиг. 41. Указатель высоты УВ-57 радиовысотомера РВ-УМ.



Fig, 42. PSV-UM Dangerous-Altitude Switch of RV-UM Radio Altimeter

Фиг. 42. Переключатель опасной высоты ПСВ-УМ радиовысотомера РВ-УМ.

Operational Check of the Radio Altimeter

Connect the airfield power source to the aircraft power circuit. Turn on the AIRCRAFT BATTERY, AIRFIELD switch located on the forward electrical panel of the starboard cockpit console, and switch on the MRP-RVU circuit breaker located on the forward electrical panel of the starboard cockpit console. Some 2-3 minutes after the altimeter has been turned on, the altitude indicator needle should come to rest at

[p 160] the zero mark on the dial within a tolerance of ±5 meters; an audible dangerous altitude signal should be heard in the pressurized helmet headset for 3-10 seconds, and the DANGEROUS ALTITUDE signal lamp on the instrument panel should light.

2. Check zero set accuracy on the radio altimeter. Should the altitude indicator needle deviate from the zero mark by more than ±5 meters, it should be brought within tolerance with the ZERO SET potentiometer on the altitude indicator.

3. Check the operation of the r-f oscillator with the aid of the I-2 Indicator furnished with the T-1 Tester set. For this purpose, a special cylindrical cartridge is placed over the TRANSMITTER peg on the transmitter. Normal illumination of the signal lamp on the I-2 Indicator signifies that the r-f oscillator is operating properly.

4. Check the operation of the antenna circuit with the aid of the I-1 Power Indicator furnished with the T-1 Tester set. This is done by passing the indicator near each of the antennas. If the antenna and feeder channels are in good condition, the lamp on the I-1 indicator will

light.

5. Check both the audio and visual signals. This requires that the DANGEROUS ALTITUDE switch be placed in the K position, after which it may be placed in any other desired position. During this procedure, both the visual and the audio signals should be activated at the appropriate altitude marks. Following completion of the test, the radio altimeter should be turned off and the airfield power source should be disconnected from the aircraft power circuit.

Chapter 4

The MRP-56P Marker-Beacon Radio Receiver

1. General Information

The MRP-56P marker-beacon radio receiver is designed for reception of signals from the UKV Marker Beacon and may be used to determine the exact moment at which the aircraft flies over a marker-beacon transmitter. The moment is indicated by the illumination of the MARKER signal lamp on the signal lamp panel, and also by the sounding of an audio signal in the pilot's helmet headphones or pressurized helmet.

The MRP-56P marker-beacon radio receiver constitutes a part of the aircraft simplified blind-landing instrument flight system.

The MRP-56P marker-beacon radio receiver consists of the following components installed on the aircraft (See figure 43):

1. Receiver
2. Intrafuselage antenna
3. Signal unit
4. Signal lamp
5. Set of wire harnesses and feeder cables

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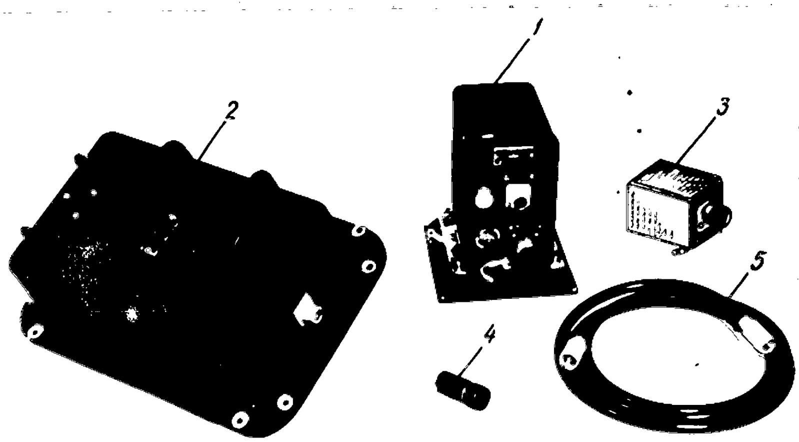

Fig. 43. MRP-56P MARKER-BEACON RADIO RECEIVER SET
1 - Receiver; 2 - Intrafuselage Antenna; 3 - Signal Unit; 4 - Signal Lamp; 5 - Cable

Рис. 43. Комплект маркерного радиоприемника МРП-56П.
1- приемник; 2-внутрифюзеляжная антенна; 3- блок сигнализации; 4- сигнальная л
5- фидер.

2. Location of Marker-Beacon Radio Receiver Units on the Aircraft

Components of the marker-beacon radio receiver are installed on the aircraft in the following locations (See figure 44):

1. The receiver is installed in the fairing of the fin between frames 33 and 33a.

[p 163] 2. The intrafuselage antenna is in the lower starboard side of the fuselage tail section between frames 30 and 31a and is located in a special compartment together with the parachute brake.

3. The signal unit is on the starboard side of the cockpit by frame 11.

4. The MARKER signal lamp is on the T-4 signal panel in the cockpit.

3. Servicing and Maintenance of the Marker-Beacon Radio Receiver

Checking and Tuning the MRP-56P

Once installed on the aircraft, the preadjusted MRP-56P marker-beacon radio receiver does not require further tuning during operation, since it is pretuned to a single preset frequency of 75 megacycles. The MRP-56P need be tuned only in case of repair or component replacement or in the event that the antenna or output circuits become detuned when checking.

Operational Check of the MRP-56P

A noise generator (buzzer) is used for the operational check along with the MIP-48 radio marker-beacon simulator in the following manner:

[p 166] 1. Connect the airfield power source to the aircraft power circuit.

2. Turn on the AIRCRAFT BATTERY, AIRFIELD switch located on the forward electrical panel of the starboard cockpit console and the MRP-RVU

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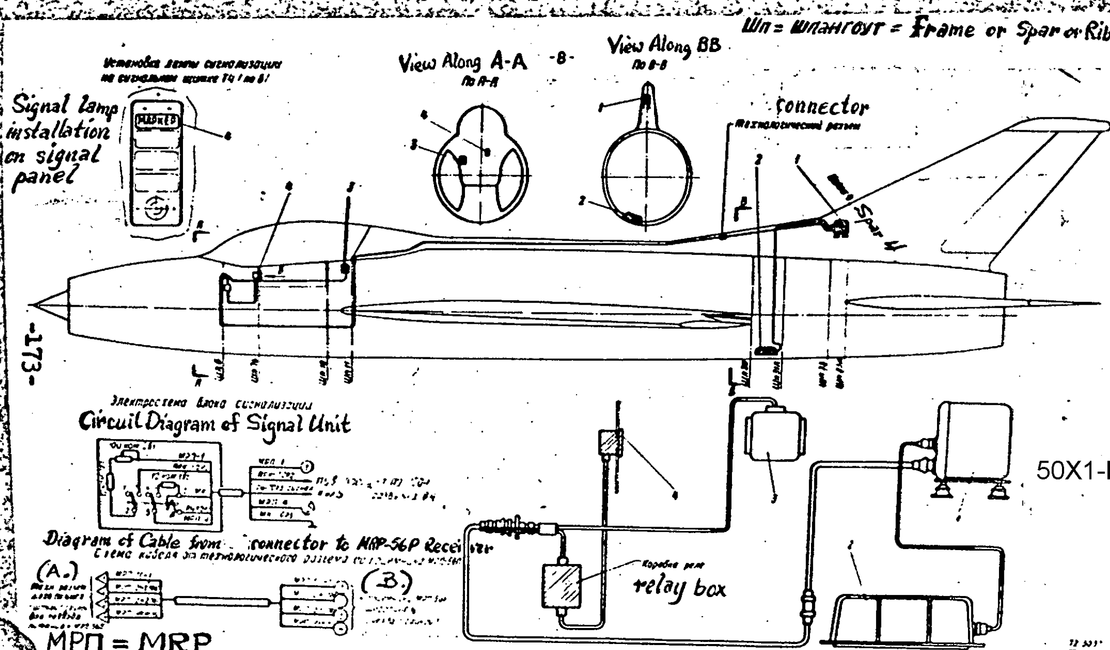

Fig. 44. Location and Interconnection of MRP-56P Marker-Beacon Receiver Units

44. Схема размещения и соединения блоков маркерного радиоприемника МРП-56П

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(A.) Disconnector ShR20Pk4NG8 (plug with nut) for supplying power to the MRP-56P receiver
(B.) ShR20P4NG8 (socket with nut) to MRP-56P receiver

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[p 165] Captions to Numbers on Fig. 44 on the Preceding Page Showing the Location and Interconnection Diagram for the MRP-56P Marker-Beacon Radio Receiver on Aircraft

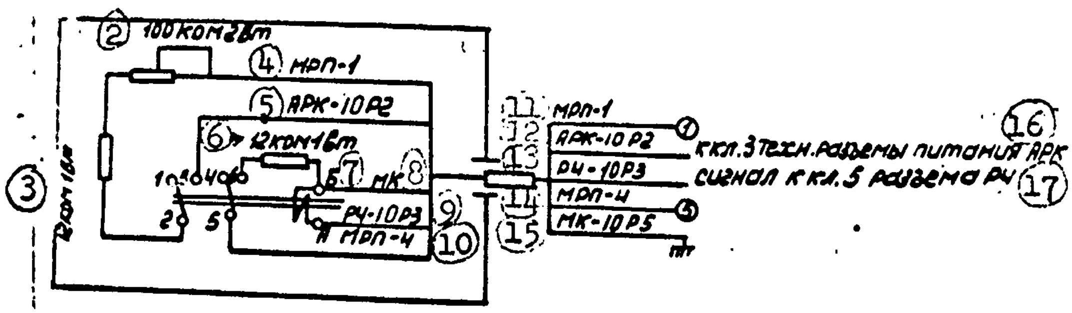
1. Receiver
2. Intrafuselage antenna
3. Signal unit
4. Signal lamp

circuit breaker also located on the electrical panel of the starboard cockpit console.

3. Allow 30 seconds for warming up the tubes, then feed a signal to the receiver antenna from the MIP-48 simulator buzzer. Hold the buzzer in the immediate vicinity of the antenna, at a distance of 10-30 cm. The simulator should be placed in the operational zone of the MRP-56P antenna, 1-2 meters away from it so that the MIP-48 antenna runs parallel to the axis of the aircraft. The MIP-48 antenna should operate on a preset frequency of 75 megacycles and the simulator FREQUENCY MODULATION switch should be placed in a position corresponding to a modulation frequency of 3,000 cycles.

4. If the MRP-56P receiver is operating normally, a 400-cycle tone signal should be heard in the helmet headset or in the pressurized helmet, and the MARKER lamp on the signal panel should light (See figure 45).

ектросхема блока сигнализации. (1)



Фиг. 45.
Fig. 45

[p 167] Captions to Numbers on Fig. 45 on the Preceding Page Showing the Circuit Diagram of the Signal Unit

1. Circuit diagram of the signal unit
2. 100 kilohm 2 watt
3. 12 kilohm one watt
4. MRP-1
5. ARK-10R2
6. 12 kilohm one watt
7. B
8. MK
9. RCh-10R3
10. MRP-4
11. MRP-1
12. ARK-10R2
13. RCh-10R3
14. MRP-4
15. MK-10R5
16. To pin 3 of the ARK power supply connector
17. Signal to pin 5 of the RCh connector

[p 168]

Chapter V

The SRD-5MK Range Only Radar

1. General Information

The range only radar is designed to determine by means of radio detection the range to the target, the approach velocity, and the moment of effective launching of the K-13 homing missile.

In the gunnery and unguided rockets mode (MODE A), the radar continuously supplies to the ASP-5PD sight voltages proportional to the range and to the relative velocity of the target.

In the K-13 rocket weapon mode (MODE B), the radar provides:

a) Automatic and continuous determination of the present range to the target and the indication of this range on the UD-1 range indicator.

b) Automatic comparison of true range with effective range of firing rockets and the transmission of the permissive signal for firing them to the green EFFECTIVE RANGE signal light.

c) Transmission of the need-to-disengage-the-attack signal to the red DISENGAGE signal lamp.

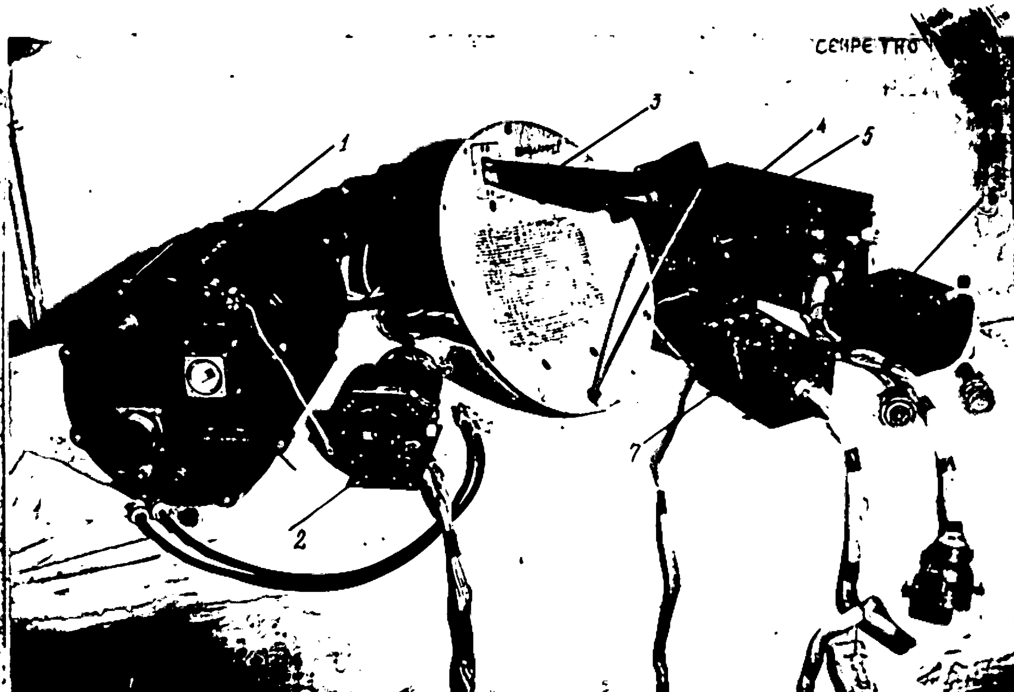
The VRD-2A effective range computer installed in the range only radar

[p 169] system supplies voltages proportional to the effective rocket launching range relative to the altitude and velocity of the rocket-carrying aircraft and to the approach velocity of the target aircraft.

The range only radar set installed in aircraft consists of the following components (See figure 46):

1. K-1 combination antenna and waveguide channel
2. RB6-2M transceiver unit
3. RB6-3 range receiver unit
4. RB6-4 power unit
5. RB6-5 velocity unit
6. K-6 control panel
7. K-8 comparator unit
8. VRD-2A effective range computer
9. UD-1 range indicator
10. DVS-5 air speed transmitter
11. P-5 temperature receiver
12. EFFECTIVE RANGE signal lamp
13. DISENGAGE signal lamp
14. RS, PUSh. -- SS (Reaktivnyy Snaryad, Pushka -- Samonavodyashchiysya Snaryad; Rocket Shell, Gun -- Homing Missile) mode switch
15. DROP TARGET button
16. Set of wire bundles and feeder cables

50X1-HUM



Фиг. 46. Комплект радиолокационного дальномера

Fig. 46. The range only radar set

[p 171] Captions to Numbers on Fig. 46 on the Preceding Page Showing the Range Only Radar Set

1. RB6-2M transceiver unit
2. RB6-5 velocity unit
3. K-1 combination antenna with waveguide channel
4. RB6-4 power supply unit
5. RB6-3 range receiver unit
6. K-8 comparator unit
7. K-6 control panel

[p 172]

2. Location of Range Only Radar Components on the Aircraft

Units of the range-only-radar set are installed on the aircraft in the following locations (See figure 47):

1. The K-1 combination antenna and the waveguide channel are located inside of the stationary section of the movable cone.

2. The RB6-2M transceiver unit is situated in the upper equipment bay, along the axis of symmetry between frames 2A and 3.

3. The RB6-3 range receiver unit and the RB6-4 power supply unit are mounted in the upper equipment bay between frames 2A and 3 above the transceiver unit.

4. The RB6-5 velocity unit is installed in the upper equipment bay between frames 2A and 3 under the range receiver unit.

5. The K-6 control panel is placed in the upper equipment bay between frames 2A and 3 to the right of and on the same level as the range receiver unit.

6. The K-8 comparator unit is located in the upper equipment bay on the port side between frames 3 and 4 behind the power supply unit.

7. The VRD-2A effective range computer is situated in the upper equipment bay between frames 4 and 5 on the upper port side closer to frame 5.

8. The DVS-5 air speed transmitter is mounted in the upper equipment bay between frames 4 and 5 on the port side under the transceiver of the RSIU-5G radio set.

[p 175] 9. P-5 temperature receiver is in the lower nose section of the fuselage next to frame 2 on the starboard side.

10. The UD-1 range indicator is located in the cockpit on special a bracket attached to the sight range indicator.

11. The BS, PUSh -- SS mode switch is in the cockpit on the vertical section of the port instrument panel.

12. The EFFECTIVE RANGE and DISENGAGE signal lamps are on a special bracket next to the VD-1 range indicator.

13. The DROP TARGET button is on the lower left of the sight head.

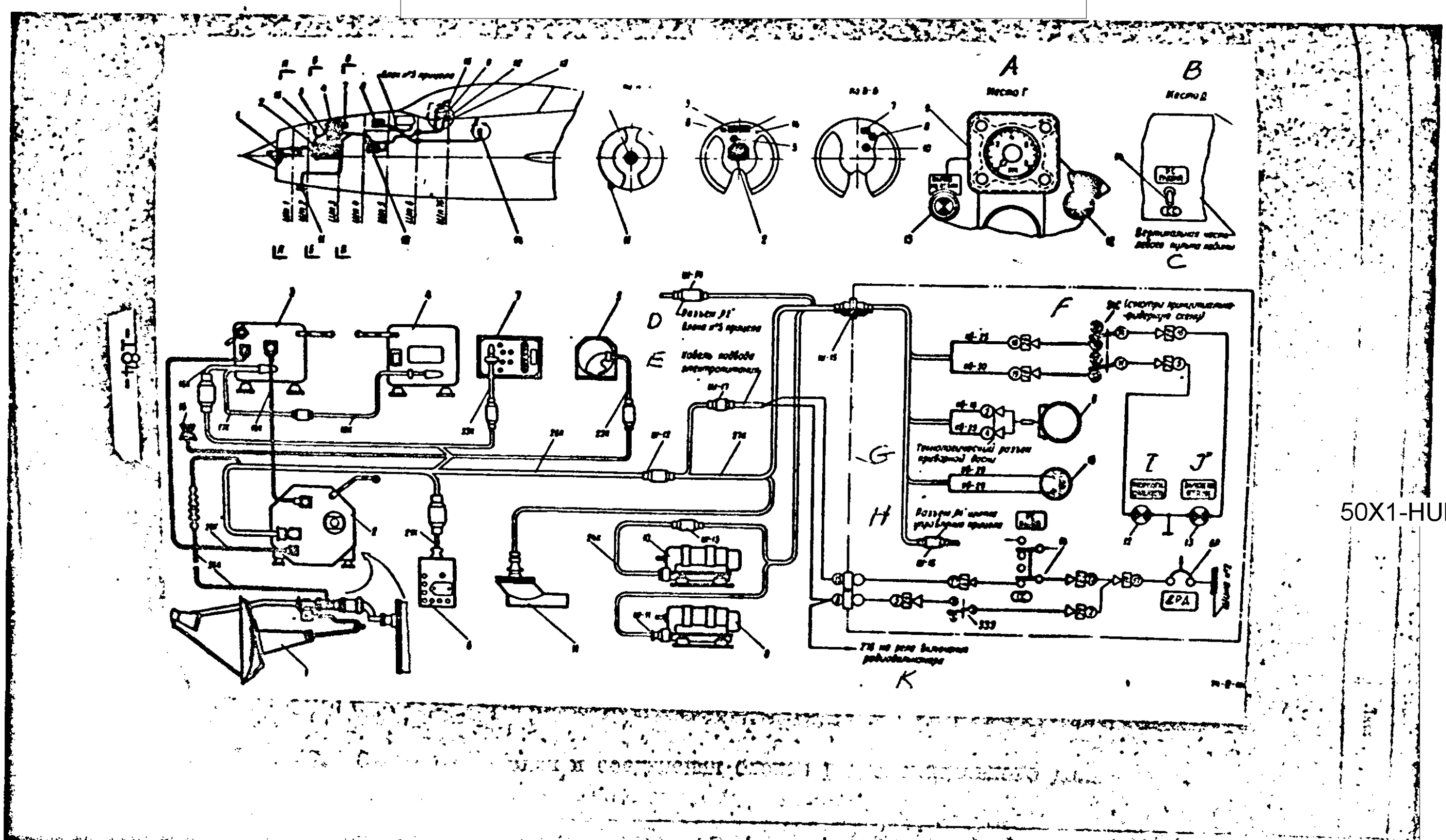


Fig. 47 Schematic diagram showing the arrangement and interconnections of range only radar units

[p 173] Captions to Letters on Fig. 47 on the Preceding Page Showing the Schematic Diagram for the Arrangement and Interconnections of Range Only Radar Units

A. Location G

B. Location D

C. Vertical part of the port cockpit console

D. R2 connector to unit 5 of the sight

E. Power input cable

F. 24C (See the main power distribution diagram)

G. Instrument panel connector

H. R1 connector on the sight control panel

I. EFFECTIVE RANGE

J. DISENGAGE

K. 27 volts to the ON-OFF relay of the range only radar [p 174] Captions to Numbers on Fig. 47 Showing the Schematic Diagram for the Arrangement and Interconnection of Range Only Radar Units

1. Combination antenna and waveguide channel
2. RB6-2M transceiver unit
3. RB6-3 range receiver unit
4. RB6-4 power supply unit
5. RB6-5 velocity unit
6. K-6 control panel
7. K-8 comparator unit
8. VRD-2A effective range computer
9. UD-1 range indicator
10. DVS-5 air speed transmitter
11. P-5 temperature receiver
12. EFFECTIVE RANGE signal lamp
13. DISENGAGE signal lamp
14. RS, PUSh -- SS mode switch
15. DROP TARGER button
16. Monitor connection

16K-27K. Set of wire bundles and feeder cables.

3. Servicing and Maintenance of the Range Only Radar

Warning

1. When working with the range only radar, remember that fatal high potential of up to 6,000 volts is present in the transceiver unit.

2. When working with the transceiver unit with the housing removed, it is categorically forbidden to touch with the hands the high-voltage rectifier, modulator, and magnetron circuits.

[p 176] Operational Check of the SRD Using the KPK Control Panel

Before undertaking the operational check of the range only radar, it is necessary to:

1. Remove the air intake baffle.

2. Connect the KPK panel to the KP monitor cable connection.

3. Connect the KPU-3 instrument to the PVD-5 (but at this time, do NOT turn on the power).

4. Set up and turn on the ventilator to cool the units.

5. Connect the external power source to the aircraft.

The operational check of the range only radar is performed in the following order:

1. Turn on the AIRCRAFT BATTERY, AIRFIELD switch and check the aircraft circuit voltage. It should measure 27 v $\pm 10\%$.

2. Set the switches on the KPK control panel in the following positions:

AGC-MGC (ARU-RRU, Avtomaticheskaya Regulirovka Usileniya-Ruchnaya Regulirovka Usileniya; AGC-MGC, Automatic Gain Control-Manual Gain Control) switch on AGC,

AFC-MFC (APCh-RPCh, Avtomaticheskaya Podstroyka Chastoty-Ruchnaya Podstroyka Chastoty; AFC-MFC, Automatic Frequency Control-Manual Frequency Control) switch on AFC,

MODE switch on 115 v.

3. Set the RADIO-OPTIC switch on the sight control panel on RADIO, the range-only-radar operational MODE switch on RS, PUSh, and the GYRO-STATIONARY switch on the sight head on GYRO.

[p 177] 4. Switch on the circuit breakers on the right panel in the following sequence: SIGHT AND SIGHT HEATER, SIGHT, SRD, and AGD [Aviagorizont Distantsionnyy; attitude indicator].

Warning: To avoid damage to the sight components by the high voltage in the range only radar set, it is forbidden to turn on the SRD before switching on the sight.

In 2.5-3 minutes after turning on the range only radar, the HIGH VOLTAGE signal lamp on the sight control panel should light indicating that the set is ready for operation.

5. By placing the MODE switch on the KPK panel in each of the following positions, 115 v, +200 v, +300 v, +150 v, and —150 v, check the input and rectified voltages which should be within the following tolerances; 115 v ± 4 v, +200 v ± 5 v, +300 v ± 5 v, —150 v ± 5 v, and +150 v $^{+10}_{-5}$ v.

6. To check the magnetron current, place the MODE switch on the KPK in the TM (Tok Magnetrona; Magnetron Current) position. Magnetron current magnitude should be 2.1 $\pm$0.6 milliamperes.

7. To check crystal current, set the MODE switch on the KPK on TK-I (Tok Kristalla; Crystal Current) and then on TK-II. The current of crystal I should be within 0.2-0.8 milliampere, and of crystal II within 0.4-1.2 milliampere.

8. To check antenna switching with ferrite commutator currents proceed as follows: first, set the MODE switch on the KPK in the TFK (Tok
[p 178] Ferritovogo Kommutatora; Ferrite Commutator Current) position and the RS, PUSh -- SS switch on RS, PUSh, and then on SS; measure ferrite currents in both positions of the RS, PUSh -- SS switch. Readings should correspond to values indicated on the ferrite commutator rating list.

9. Check the operation of the range only radar in conjunction with the sight.

a) Set the switch on the unit 7 of the sight in the NR-30 position.

b) Check for lock on reflected signals from ground objects in front of the aircraft.

Presence of lock-on is indicated by the illumination of the green LOCK ON signal lamp located on the sight head. At this time, the D dial on the sight computer should operate and the range indicator on the sight head should indicate the proper range. The sight grid should decrease in diameter and drop down a little if the sight was preset for minimum range prior to lock-on.

c) Set the MODE switch on the KPK panel in the U_D position and check the range of the locked-on target.

d) Check the operation of the DROP TARGET button located to the left of the sight head; when the button is depressed the LOCK ON signal light should go out, and when released, light again.

[p 179] 10. Check the operation of the range only radar in conjunction with the VRD-2A sight.

a) Set the GYRO-STATIONARY arrester control located on the sight head in the STATIONARY position.

b) Place the BS, PUSh -- SS switch on SS.

c) Bring the MN-5 neon lamp close to the antenna fairing. The lamp should light.

d) Switch on the AGD circuit breaker.

e) To check the direction of movement of the VRD-2A dial in relation to the discharge produced in the PVD system, gradually induce with the KPU-3 instrument a discharge in the PVD corresponding to an altitude of 1,000-2,000 meters and make sure that the VRD-2A dial begins to rotate counterclockwise in the direction of the increasing ratio $\frac{V_H}{H}$; where, V_H is the velocity at a given altitude, and H is the altitude. Inversely, with a gradually-diminishing-to-zero discharge, the VRD-2A dial should rotate clockwise in the direction of the decreasing ratio $\frac{V_H}{H}$.

<u>Note</u>: The VRD-2A dial is for reference only and serves to check the over-all operational capability of the computer.

[redacted]

11. Check the operation of the EFFECTIVE RANGE and DISENGAGE signal circuits.

a) To check the operation of the EFFECTIVE RANGE signal circuit, proceed as follows:

[p 180] Connect OUTPUT D and OUTPUT VRD terminals on the K-8 unit to the corresponding terminals on the KPK panel (See figure 48).

Place the CALIBRATION switch on the KPK control panel in the ON position. Locate the STATION MODE switch on the KPK on S. With the ERROR potentiometer, set the ERROR meter to read zero. Place the KPK RANGE switch on 2,000 meters. Lock on the 2,000-meter marker from the UKKM-1 [an r-f calibrator].

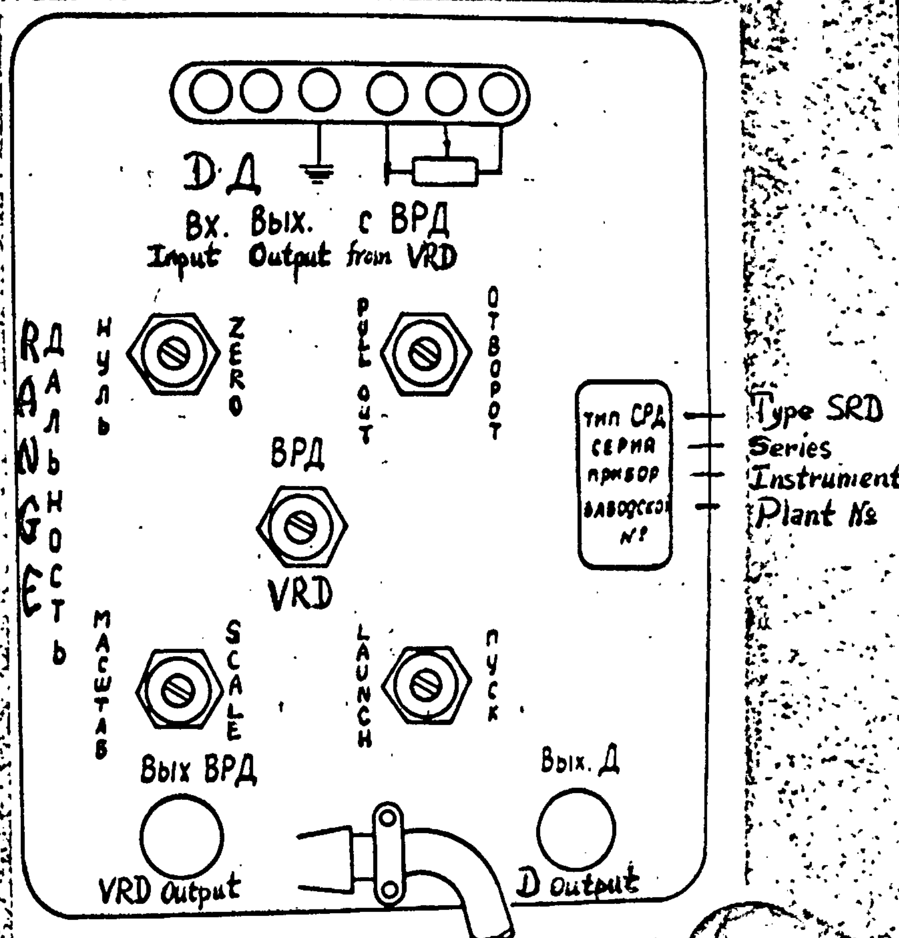
By rotating the ERROR potentiometer on the KPK and by flipping the + -- — switch back and forth attempt to light the EFFECTIVE RANGE signal in the range of the ERROR meter dial. Ranges of 3,000, 4,000, and 5,000 meters are checked in the same manner. The error in the comparison of the two voltages should not exceed ±100 meters.

b) To check the operation of the DISENGAGE signal circuit, connect the OUTPUT D terminal on the KPK to OUTPUT D terminal on the K-8 unit. Set the CALIBRATION switch on the KPK on CALIBRATION.

Set the STATION MODE switch on the KPK panel on O. With the ERROR potentiometer, bring the needle on the ERROR meter to maximum. Place the + -- — switch on +.

Lock on the 1,000-meter marker from the UKKM-1 calibrator. By rotating the ERROR potentiometer on the KPK, try to light the DISENGAGE signal lamp

№181



Фиг.48. БЛОК СРАВНЕНИЯ (блок К-8)

Fig. 48 The K-8 Comparator Unit

in the range of the ERROR meter dial.

[p 182] After completing the check, disconnect the instrument and switch off the circuit breakers turned on during the test. Remove the ventilator and replace the air intake baffle.

<u>Note:</u> When locking on a simulated target from the UKKM-1 instrument, a special rubber baffle should be placed on the air intake.

<u>Synchronizing the Range Only Radar with the VRD-2A, DVS-5 and P-5</u>

Synchronization of the range only radar with the VRD, the DVS-5, and the P-5 should be performed as follows:

1. Connect the external power source to the aircraft.

2. Turn on the AIRCRAFT BATTERY, AIRFIELD switch located on the starboard console.

3. Switch on the circuit breakers on the right panel in the following sequence: SIGHT AND SIGHT HEATER, SIGHT, SRD, and AGD.

4. Connect a high-resistance voltmeter with an internal resistance of 1,000 kilohms to the S and VRD ZAP. test points on unit 8 of the range only radar.

5. Check the range-only-radar output voltage to the VRD-2A. If the voltage does not correspond with the value on the rating list for the VRD-2A, then by adjusting the CALIBRATION VRD potentiometer on unit 8, bring it to the correct value.

6. Connect the UKKM-1 calibrator to the coaxial cable between units 2 and 3 (PUPCh and UPCh; i-f preamplifier and i-f amplifier).

[p 183] 7. Connect the high-resistance voltmeter to the S and the OUTPUT VRD test points in unit 8 of the range only radar.

8. Connect the KPU-3 monitor and test equipment (do not connect the dynamic wire) to the static wire of the PVD-5 and induce a discharge in the circuit corresponding to an altitude of 1,000-2,000 meters. The computer dial should now begin to rotate counterclockwise toward the maximum value of $\frac{V_H}{H}$, and the reading on the monitor instrument should decrease from 27 volts to about 5 volts.

9. Place the RADIO-OPTIC switch on the sight control panel on RADIO.

10. Lock on the 2,000-meter calibration marker from the UKKM-1 calibrator.

11. Increase the discharge in the PVD circuit to 4,000-4,200 meters, and make sure that the VRD-2A dial moves in the opposite direction from maximum range and that the EFFECTIVE RANGE signal lamp is lit.

12. As soon as the EFFECTIVE RANGE signal lamp lights, switch off the AGD circuit breaker and check the range-only-radar output voltage to the VRD-2A. It should be 7.26 volts $\pm$0.32 volts.

[p 184] <u>Check of the RVD-2A Error When Operating in Conjunction with the Range Only Radar, the DVS-5, and the P-5</u>

1. Induce a discharge in the static wire of the PVD corresponding to an altitude of 5,000 meters.

Monitor the altitude on the aircraft altimeter which should be preset to the day's atmospheric pressure with the rack gear with allowance for instrument error. Measure the potential between S and OUTPUT VRD test points in unit 8. It should be 8.67 volts ±0.45 volts.

Note: 1. The check of the VRD-2A in accordance with subsection 1 is valid if performed when the ambient temperature of the P-5 receiver is +20° ±5° C.

Should the VRD-2A be checked at different temperatures, then it will be necessary to make corrections in accordance with table 1.

Table 1

P-5 Receiver Ambient Temperature (°C)	Voltage for Altitude H = 5 km (Volts)
—60	9.834-10.866
—50	9.459-10.605
—40	9.5-10.5
—30	9.29-10.27
—20	8.98-9.92
—10	8.76-9.68
0	8.66-9.575
+10	8.55-9.45
+20	8.22-9.12
+30	8.14-9.0
+40	8.03-8.87
+50	7.81-8.63
+60	7.66-8.46

[p. 185]

2. Dials on the VRD-2A and DVS-5 instruments are for reference only and serve to check the over-all operational capability of the above mentioned units.

3. If according to the altimeter, the day's atmospheric pressure is not equal to 760 mm, then table 2 should be used.

Table 2

Atmospheric Pressure Set by VD-20 Rack Gear (mm)	Readings at H=0 After Setting With Altimeter Rack Gear (meters)	Given Altitude Altimeter Reading for H=5 km (meters)
790	—330	4,500
780	—200	4,700
770	—100	4,880
762.76	0	5,000
750	+100	5,200
740	+200	5,400
730	+330	5,500

[p 186] Check of the Range Only Radar Antenna Alignment

The alignment check of the range only radar antenna is performed when the aircraft armament is aligned.

To check the accuracy of antenna alignment, the sight guard should be marked to indicate the center of the antenna relative to the axis of symmetry, aircraft datum line, sight, and other armament.

In placing the sight target at a distance of 10 meters from the aircraft, the center of the reference circle for checking the accuracy of the position of the antenna is placed on the axis of symmetry 800 mm above the aircraft datum line.

The antenna is considered correctly aligned, if the cross hairs of the sight harmonization tube are within the 30' diameter of the reference circle.

After the harmonization of the armament, check the accuracy of antenna alignment as follows:

1. Remove the antenna fairing.

2. Fasten to the antenna reflector the attachment from the range only radar spare parts set for installing the sight harmonization tube.

3. After mounting the sight harmonization tube in the center of the attachment, look through it and check the alignment of the optical axis with the mark on the guard for checking the accuracy of antenna alignment.

If the tube cross hairs do not coincide with the mark (i.e., they [p 187] fall outside of the reference circle), then it is necessary to:

a) Remove unit 1 of the range only radar from the mounting bracket.

Detach the waveguide unit from the horn antenna located in the forward bay and remove the reflector antenna from the waveguide. Unscrew the four bracket retaining screws.

b) Loosen the external screws of the bracket holding the tube.

c) Insert the alignment washers provided with the spare parts and tool set of the aircraft.

d) Tighten the bracket mounting screws and replace unit 1 of the range only radar, but do not install the waveguide channel in the forward section. Make sure that the sighting mark is within the 30' diameter of the reference circle.

e) After completing the alignment, secure the waveguide channel to unit 1 of the range only radar at the above-mentioned points.

f) Test the waveguide channel for hermetic seal.

__Warning:__ In installing and removing the equipment be careful not to damage the guard and the horn antenna emitter.

__Check of the RB6-2M Unit and the Antenna Waveguide for Hermetic Seal__

The RB6-2M unit is tested for hermetic seal with the help of special equipment. To accomplish this, tighten the tie bolts of the RB6-2M hous-
[p 188] ing. Pump in an excess pressure of 0.9 atm through the intake nipple on the face panel of the unit. The test is considered satisfactory if the pressure does not drop more than 0.1 atm in one hour.

The check of the antenna waveguide system for hermetic seal is done by pumping an excess pressure of 0.9 atm into the antenna waveguide channel with the manometer (in the waveguide by the RB6-2M unit).

The test is considered satisfactory if the pressure drop in the wageguide does not exceed 0.1 atm per hour, provided the total volume of the hose connected to the waveguide system is not over 40 cm^3.

Check of the Geometrical Alignment of the K-1 Unit Emitter

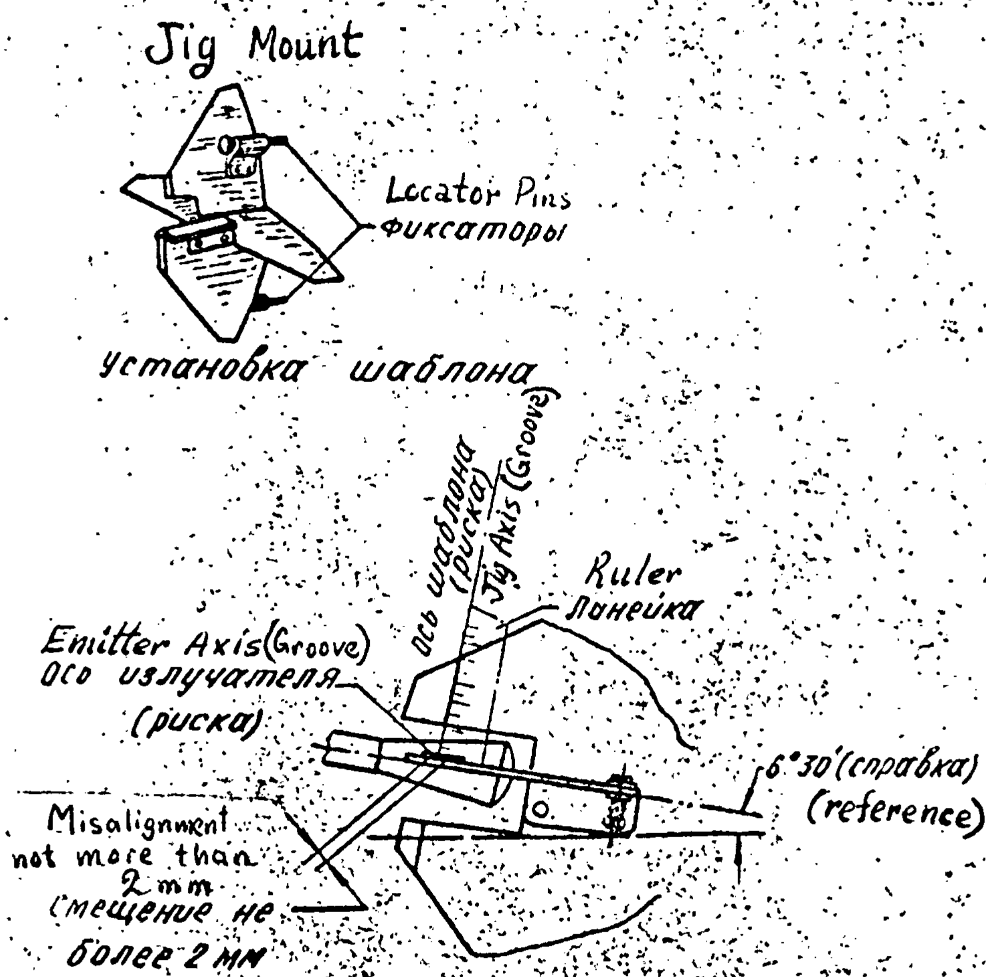
This check is for the purpose of determining whether the geometrical and electrical axes of the emitter are coincidental (See figure 49).

A special templet is used in this test and is provided with the aircraft spare parts set.

The templet is placed on the K-1 unit, is locked in place with special pins inserted into appertures under the upper left and the lower right (facing the tail) mounting bolts of the K-1 unit (the mounting bolts [p 190] should be unscrewed beforehand), and is positioned along the slot of the top screw for mounting the alignment attachment on the K-1 unit. Misalignment of the geometrical axes (grooves) of the emitter in relation to the templet axes (grooves) is measured with a ruler.

When measuring, the ruler is always placed on the slot inscribed at the beginning of the groove on the templet. Measurements are made in both the horizontal and vertical planes. Misalignment in each of the planes should not exceed 2 mm.

This check is made only in the event that the K-1 unit has been previously removed from the aircraft for any reason.



Фиг. 49. Проверка геометрического положения излучателя блока № I.

Fig. 49. Checking Geometric Alignment of Emitter of Unit No. I

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Over-all Operational Capability Check of the Range Only Radar

1. Connect the airfield power source to the aircraft.

2. Turn on the AIRCRAFT BATTERY, AIRFIELD switch located on the the starboard console

3. Remove the air intake baffle.

4. Set the RADIO-OPTIC switch on the sight control panel on RADIO.

5 Switch on the circuit breakers on the starboard console in the following order: SIGHT AND SIGHT HEATER, SIGHT, SRD, and AGD.

[p 191] After the range only radar is turned on, the HIGH VOLTAGE signal lamp located on the sight control panel should light after a delay of 2.5-3 minutes.

6. Check for lock on objects of known range in front of the aircraft. Lock-on is indicated by the illumination of the green LOCK ON signal lamp on the sight head.

Lock-on is checked in both modes of the range only radar set.

To check for the presence of lock-on in the cannon-and-unguided-aircraft-rocket mode, it is necessary to:

a) Place the range only radar RS, PUSh -- SS mode switch on RS, PUSh.

b) Set the GYRO-STATIONARY switch on the sight head on GYRO.

c) Make sure that the radar locked on target by checking to see that the green LOCK ON signal lamp on the sight head is lit. The indicator located on the left side of the sight head will now show the range to the target.

d) Depress the DROP TARGET button located on the left side of the sight head and lock on several other targets. Note the lock-on ranges on the sight indicator.

To check for the presence of lock-on in the guided-aircraft-rocket mode, it is necessary to:

a) Place the RS, PUSh -- SS mode switch in the SS position.

[p 192] b) Set the GYRO-STATIONARY switch on the sight head on STATIONARY.

c) Make sure that the radar locked on target by checking to see that the green LOCK ON signal lamp on the sight head is lit. The indicator located on the right side of the sight (on the instrument panel) will now show the range to the target.

d) Depress the DROP TARGET button and lock on several other targets, note their ranges on the indicator.

e) Make sure that when the radar locks on targets with ranges of less than 1,000 meters, the DISENGAGE signal lamp is lit. When lock-on range exceeds 1,000 meters, the signal lamp should be out.

After completing the check, place all circuit breakers and switches in their initial positions. Disconnect the airfield power source from the aircraft and replace the air intake baffle.

[p 193]

Chapter VI

Aircraft Responder of the SRO-1 Radar IFF System

1. General Information

The aircraft responder of the SRO-1 radar IFF system identifies an aircraft to its own armed forces by means of coded radar replies to challenges from aircraft, ground, or shipboard interrogators.

The SRO-1 responder can communicate with a number of interrogators which may operate on different frequencies. The response to these challenges is provided by automatic continuous frequency change over a time interval, covering a frequency range of 160-170 megacycles. Continuous frequency change is obtained by varying the inductance of the r-f circuit by sweeping a short-circuited tuning loop inside it. The frequency shift time interval from minimum to maximum value and back is 0.64 second and is equivalent to one full sweep cycle.

Reception of challenges and transmittal of response signals occurs at practically the same frequency tuning of the loop. The response signals are in Morse code. A short-duration pulse corresponds to a DOT, and a long-duration pulse (2.5-3 times as long as the short pulse) corresponds to a DASH.

[p 194] Each code in the above-mentioned code system represents one letter of the Morse code, which consists of a maximum of four transmissions. In order to avoid ambiguity when reading the code, the letters are separated

by pauses. Thus, a code consists of a group of dots, dashes, and pauses, which form a five-cycle transmission (the fifth is a pause) and takes 3.2 seconds for transmission.

The responder has 12 single-letter codes. In addition, the responder provides a special SOS signal -- a wide pulse, the duration of which is considerably longer than the usual pulse of any code.

To prevent the responder from falling into enemy hands there is a detonator which destroys the transceiver. The detonator is activated either by a detonator button which is operated by the pilot and located in the cockpit on the horizontal section of the starboard console, or by an automatic inertial contactor which trips if the aircraft is falling.

Warning: The SRO-1 aircraft responder must be destroyed under the following conditions:

1. In the event of an aircraft emergency over enemy territory or if the pilot abandons the aircraft in the air.
2. In the event of forced landing in enemy territory.
[p 195] 3. In any circumstance when preservation of the secrecy of the responder is not guaranteed.

The responder of the SRO-1 radar identification system in the aircraft consists of the following components:

1. Antenna
2. Transceiver
3. Code board
4. INERTIA contactor

5. Detonator circuit control board

6. DETONATE button

7. SOS extension switch

8. F-14A filter

9. Set of wire bundles and feeder cables.

[p 196] 2. Location of Responder Units on Aircraft

Responder units are installed in the following locations on the aircraft (See figure 50):

1. The transceiver is located in the upper equipment compartment between frames 5 and 6.

2. The antenna is mounted at the top of the main fuselage section between frames 21 and 22.

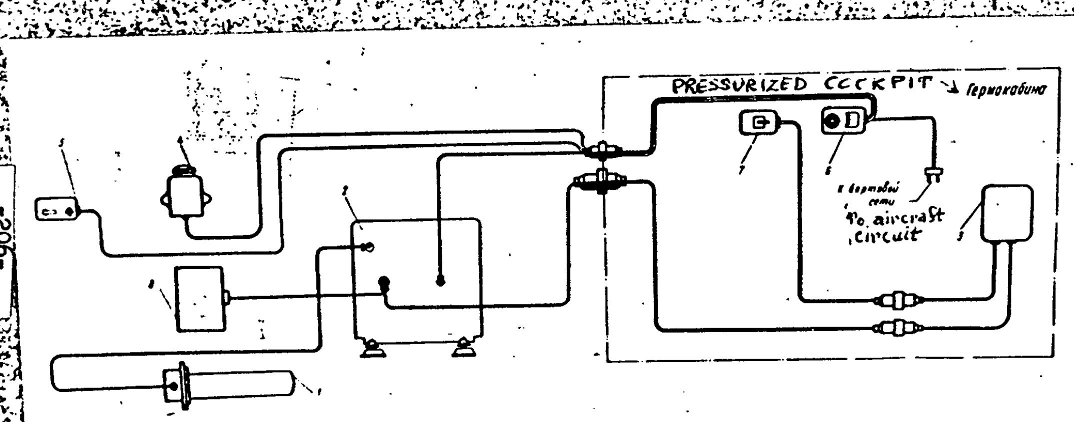
3. The code board is installed in the cockpit on the vertical part of the starboard console.

4. The INERTIA contactor is located on the port side of the upper equipment compartment, between frames 3 and 4.

5. The detonator circuit control board is on the left in the upper equipment compartment between frames 5 and 6.

6. The DETONATE button and the SOS signal switch are placed in the cockpit on the horizontal part of the starboard console.

7. The F-14A filter is in the upper equipment compartment.



Фиг. 50. Схема соединения блоков ответчика системы радиолокационного опознавания СРО-1.

1- антенна; 2- приемопередатчик; 3- кодовый щиток; 4- инерционный выключатель; 5- щиток контроля цепи взрыва; 6- кнопка взрыва; 7- выносной переключатель; 8- фильтр Ф-14А.

Fig 50 Unit interconnecting diagram for the SRO-1 IFF responder

Captions to Numbers on Fig. 50 on the Preceding Page Showing the Unit Interconnecting Diagram for the SRO-1 Radar IFF Responder

1. Antenna
2. Transceiver
3. Code board
4. INERTIA contactor
5. Detonator circuit control board
6. DETONATE button
7. Extension switch
8. F-14A filter.

3. Maintenance and Servicing of the Responder

Precautionary Measures

The transceiver of the SRO-1 system uses a high operation potential, which is not turned off when the unit cover is removed. Besides, the transceiver has a detonator, which if carelessly handled may lead to serious injury to maintenance personnel and to the destruction of the set.

[p 198] Warning: Remember that the detonator circuit is connected directly to the storage battery and is always live.

To ensure the safety of maintenance personnel and to avoid putting the transceiver out of commission, the observance of the following precautions is compulsory:

1. Do not remove the cover from the transceiver and do not perform repair work on the SRO-1 set when it is turned on.

2. When working with opened units observe caution and do not touch the high voltage circuit of the transmitter and other parts of the circuit.

3. Do not jar the INERTIA contactor or even accidentally press the DETONATE button as this may result in the destruction of the set.

4. Before starting work on the aircraft, open the access door on the cover of the upper forward compartment and place the switch on the detonator circuit control board on OFF. Only during flight should this switch be located in the ON position.

[p 199] #### Operating the Responder

The responder is operated by remote control from the code board (See figure 51). Its operation is designed to include a minimum number of steps.

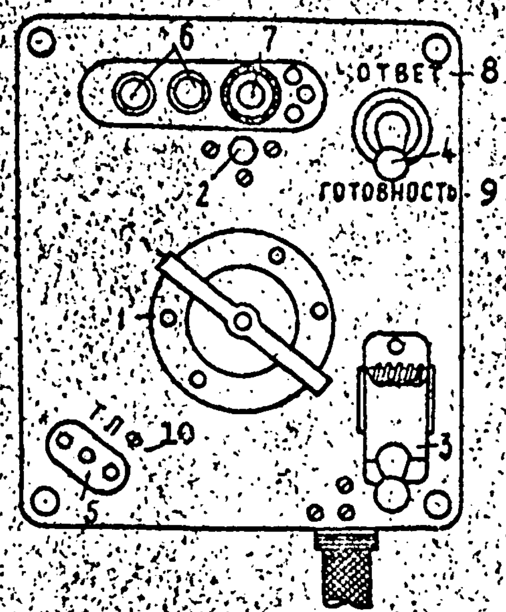


Fig. 51 SRO-I Responder Code Board

Фиг. 51. Кодовый щиток ответчика СРО-I.

I. Переключатель кодов.

2. Смотровое окно шкалы

3. Выключатель для включения сигнала "Бедствие"

4. Переключатель рода работы "Готовность - Ответ"

5. Разетка для включения контрольных головных телефонов.

6. Индикаторные лампы.

7. Ручка для регулировки силы свечения ламп (потенциометр)

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Captions to Numbers on Fig. 51 on the Preceding Page Showing the SRO-1 Responder Code Board

1. CODE switch
2. Dial window
3. SOS signal ON switch
4. READY -- RESPOND mode selector switch
5. MONITOR HEADPHONE plug
6. Pilot lamps
7. LAMP DIMMER control (potentiometer)
8. RESPOND
9. READY
10. PHONE

1. To start the responder, turn on the power by switching on the SRO switch located on the front electrical panel on the starboard console, and after a 2-3 minute delay, place the MODE switch on the code board in the RESPOND position. This will light the illumination lamps.

2. To change responder codes (according to a preset schedule) rotate the CODE selector switch. The number of the selected code will show in the dial window.

3. To send distress signals, remove the metal seal fastening the cover bracket to the SOS switch and place the switch in the ON position.

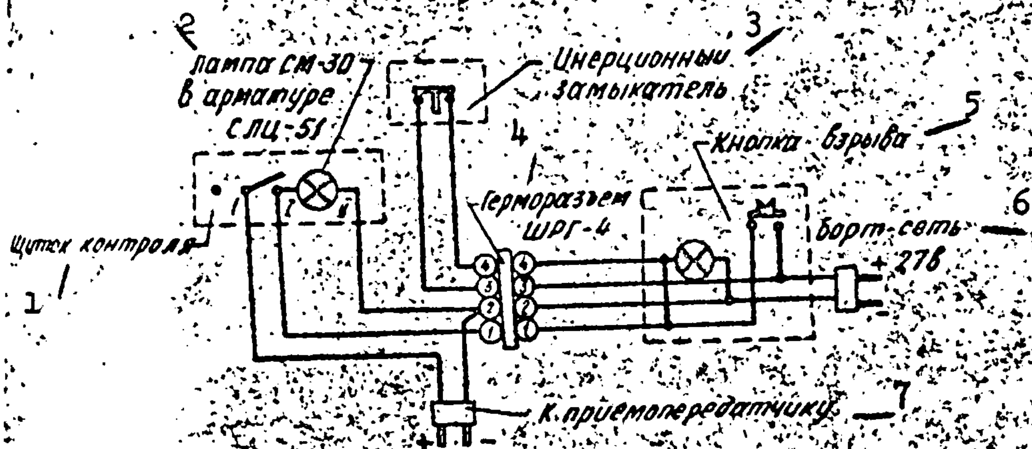
4. Check the code by the CODE INDICATOR LAMPS. The SRO-1 pretuned responder installed in aircraft does not require tuning during operation because it is tuned to predetermined fixed frequencies.

Reliability Check of the SRO-1 Detonator Circuit

1. Make sure that the OFF-ON switch on the detonator circuit control board is on OFF (See figure 52).

[p 201] 2. Make sure that the DETONATOR CIRCUIT PILOT LAMPS by the button and on the detonator circuit control board are out.

Warning: Should the DETONATOR CIRCUIT PILOT LAMPS be lit, this indicates that there is a fault in the SRO-1 detonator circuit. To avoid detonation of the set in this case, the switch on the control panel must not be placed in the SRO DETONATE position. The fault in the detonator circuit must be found and eliminated.



Фиг. 52. Электрическая схема жгута цепи взрыва станции СРО.

Fig. 52. SRO Electrical Detonator-Circuit Diagram

Captions to Numbers on Fig. 52 on the Preceding Page Showing the Electrical Diagram of the SRO Detonator Circuit Board

1. Control board
2. SM-30 lamp in SLTs-51 mount
3. INERTIA contactor
4. ShRG-4 pressurized connection
5. DETONATE button
6. +27-volt aircraft power supply
7. To the transceiver

3. Press the SRO DETONATE button, the pilot lamps by the button and on the detonator circuit control board must light. Release the button, and the lamps must go out.

4. Make sure that the INERTIA contactor does not function. To do this, lightly tap by hand the inertia contactor housing and make sure that the contactor is not triggered.

Note: Triggering the INERTIA contactor produces a sharp click, the top of the contactor circuit holder (red color) will move away from the center of the transparent cap, and the DETONATOR CIRCUIT PILOT LAMPS will light.

[p 203] Check of Responder Operation with the Use of the SG Signal Generator and the SV Wavemeter Test Instruments

1. To set up the SG and the SV test instruments, proceed as follows:

a) Plug in the earphones into the jack on the front panel of the signal generator.

b) Turn on the signal generator by positioning the ON-OFF switch on the front panel on ON. The indicator lamp on the front panel of the signal generator will light and a low frequency tone will be heard in the earphones, indicating that the signal-generator is ready for use.

c) Place the PULSE REPETITION RATE control knob marked HIGH - TONE - LOW in the middle position.

d) Open the cover of the SV wavemeter, take out the antenna attached to the inner side of the cover and insert it in the jack located on the upper side of the housing.

e) Turn on the SV wavemeter power by placing the ON-OFF switch on the front panel in the ON position.

f) Set the HIGH-LOW sensitivity switch on the front panel of the wavemeter in the optimal position for maximum declination of the needle to the right.

[p.204] g) To note the top and low calibration frequencies of 160 and 170 mc on the SG signal generator with the help of the SV wavemeter, proceed as follows:

Place the SG signal generator 0.5-1 meter from the SV wavemeter.

Tune the wavemeter to 170 mc with the help of the FINE and COARSE dials.

Tune the SG signal generator to the same frequency by turning the vernier. The point on the signal generator dial where the wavemeter needle is at left maximum note as the upper calibration frequency.

Note the lower calibration frequency of 160 mc on the SG signal generator in similar manner.

Turn off the SG signal generator and the SV wavemeter.

2. To check the operational capability of the responder proceed as follows:

a) Connect the external power source to the aircraft power circuit and turn on the AIRCRAFT BATTERY, AIRFIELD circuit breaker on the forward electrical panel of the starboard cockpit console.

b) Place the MODE switch on the code panel in the READY position and turn on the SRO circuit breaker on the forward electrical panel of the starboard cockpit console.

[p 205] c) Place the signal generator 2-5 meters from the responder antenna.

d) Turn on the SG signal generator power and set the tuning knob at mid-point of the calibration frequencies.

e) Set the MODE switch on the code panel in the RESPOND position.

When the responder is operating normally, a tone will be heard in the earphones (connected to the PHONE jack on the code panel) corresponding to the pulse repetition rate of the SG signal generator. The indicator lamps on the code panel will light according to a predetermined code.

When the SG signal generator is turned off, the tone in the earphones will disappear; however, clicks from the responder code circuit may be heard in the earphones.

When the SG signal generator is turned off, the high frequency whistle generated by the self-activating responder should not be heard.

When the SG signal generator is turned off, the responder may be triggered from outside interference. This may cause some crackling to be heard in the earphones and may illuminate the indicator lamps on the code board in accordance with the set code.

f) Check that the code correctly corresponds to the CODE switch location for the day.

[206] Note: Sending a narrow pulse, lights one lamp on the code panel; sending a wide pulse, lights two lamps. Sending SOS pulses, lights both lamps on the code panel with no pauses between transmissions.

After checking, place the SOS switch on OFF and the MODE selector switch on READY. Turn off the SRO circuit breaker and disconnect the airfield power.

Check of Over-all Operational Capability

1. Connect the aircraft power circuit to the airfield power source.

2. Turn on the AIRCRAFT BATTERY, AIRFIELD and the SRO circuit breakers located on the forward electrical panel of the starboard console in the cockpit.

3. Set the required code and plug in the earphones into the PHONE jack on the code panel.

4. Place the READY -- RESPOND switch on the code panel in the READY position.

5. Turn on the buzzer and place it at a distance of 10-20 cm from the responder antenna.

6. Locate the READY -- RESPOND switch on the code panel in the RESPOND position. Check coding accuracy by the signals in the earphones and by the illumination of the CODE INDICATOR LAMPS on the code panel.

7. Turn off the buzzer and the responder and disconnect the airfield power source.

Chapter VII

Preflight Check of Aircraft Radio Equipment

1. Preliminary Check

The preliminary check is the essence of the preflight check of aircraft radio equipment.

The preliminary check consists of:

a) Postflight inspection and operational check of radio equipment units.

b) Elimination of faults which appeared in flight or during post-flight inspection.

Warning: Before performing the prliminary check, make sure that the responder detonator circuit power is turned off.

The RSIU-5G Radio Set

1. Debrief the pilot on the performance of the radio.

2. By visual inspection, check the pressurized helmet headset, paying special attention to the condition of leads and connectors.

3. Make sure that the rod antenna is secure and intact.

4. Check the outside appearance, fastenings, bonding, connectors, harnesses, and r-f feeders of the radio set components.

5. Eliminate the faults which appeared in flight or during postflight inspection.

6. When using the laryngophone, check the operation of the radio set
[p 208] and its controls by establishing communication on all channels with an airfield radio station or with another aircraft radio; when using the microphone, check by establishing communication on service channels only.

The ARK-10 Radio Compass

1. Debrief the pilot on the performance of the radio compass in flight.

2. Conduct a visual inspection of the glass cover of the frame inside the fuselage. Make sure it is not soiled or mechanically damaged.

3. Check the outside appearance, fastenings, connectors, wire harnesses, r-f feeders, and bonding of the radio compass components.

4. Eliminate the faults which appeared in flight or during post-flight inspection.

5. Check the operation of the radio compass by receiving signals and by tracing the course angle of short- and long-range airfield homing radio stations; check the operation on other sub-bands by receiving signals and by finding the direction of long-range-homing and broadcasting stations; and check the accuracy of repetitive tuning to preselected frequencies at the appropriate position of the dial and the accuracy of the dial by tuning to a stable broadcasting station.

The RV-UM Radio Altimeter

1. Debrief the pilot on the performance of the RV-UM radio altimeter.

2. Make sure the antenna is secure and intact.

3. In the upper compartment, check the outward appearance, fastenings, and bonding wires of the transceiver.

[p 209] 4. In the cockpit, check the outward appearance and fastening of the ALTITUDE indicator, the DANGEROUS ALTITUDE switch, and the DANGEROUS ALTITUDE INDICATOR lamps.

5. Eliminate the faults which appeared in flight or during post-flight inspection.

6. Check the operation of the radio altimeter by observing the altitude indicator needle after turning on and signaling a given flight altitude.

The MRP-56P Marker-Beacon Radio Receiver

1. Debrief the pilot on the performance of the MRP-56P in flight.

2. Visually inspect the intrafuselage glass cover of the antenna. Make sure it is not smudged or mechanically damaged.

3. Check the outward appearance and fastening of the signal unit in the cockpit.

4. Eliminate the faults which appeared in flight or during post-flight inspection.

5. Check the operation of the MRP-56P marker-beacon radio receiver with the aid of any marker beacon simulator.

The Range Only Radar

1. Debrief the pilot on the performance of the range only radar in flight.

2. Conduct a visual inspection of the radar antenna fairing.

3. In the upper compartment, check the outward appearance and fastening of units, bonding of connectors, wire harnesses, waveguides, and r-f feeders.

[p 210] 4. In the cockpit, check the outward appearance and fastening of the UD-1 range indicator, MODE switch, signal lamps, and the DROP TARGET button.

5. Check the operation of the range only radar with the KPK control panel (the operational capability check of the range only radar is conducted together with armament specialists).

The SRO-1 Responder

1. After a flight, disconnect the power supply to the detonator circuit.

2. Debrief the pilot on the performance of the responder in flight.

3. Check mounting and intactness of the antenna on the fuselage.

4. In the upper compartment, check the outward appearance, bonding wires, and fastening of units, and the condition of the INERTIA contactor.

5. In the cockpit, check the outward appearance and fastening of units and safe-locking of the DETONATE button cover.

6. Eliminate the faults discovered in flight or during postflight inspection.

7. Check operational capability by signals from a ground station or with any simulator buzzer (check coding by both light and audio signals).

2. Preflight Check

The preflight check of radio equipment is performed from a prepared check list immediately before a flight and consists of:

a) Visual inspection and over-all operational capability check of radio equipment components.

[p 211] b) Setting of fixed frequencies, wave bands, and codes required for the given flight.

Warning: Before beginning the preflight check, make sure that the responder detonator circuit power is turned off.

The RSIU-5G Radio Set

1. Make sure that the antenna is secure and intact.

2. In the cockpit, check the outward appearance and fastening of the control panel, the UK-2M amplifier, and the decoupling transformer.

3. With the use of the laryngophones or microphone, depending on the flight mission, check the operation of the radio set by establishing

communication on service channels with an airfield radio station or with a radio of another aircraft; listen to your own transmission on the remaining channels.

4. After completing the check, place all switches and controls in the initial position and turn off the radio.

The ARK-10 Radio Compass

1. Make sure the common rod antenna is secure and intact.

2. In the cockpit, check the outward appearance and fastening of the control panel, the REMOTE FREQUENCY SELECTOR switch, tuning and course indicators, and the SHORT RANGE -- LONG RANGE switch.

[p 212] 3. Check the operation of the radio compass by receiving signals and by tracing the course angle of short- and long-range airfield homing radio stations; check the operation on other sub-bands by receiving signals and by finding the direction of long-range homing and broadcasting stations; and check the accuracy of repetitive tuning to preselected frequencies at the appropriate position of the dial.

After completing the check, place all switches and controls in the initial position and turn off the radio compass.

The RV-UM Radio Altimeter

1. Make sure the antenna is secure and intact.

2. In the cockpit, check the outward appearance and fastening of the ALTITUDE indicator, the DANGEROUS ALTITUDE switch, and the DANGEROUS ALTITUDE INDICATOR lamps.

3. Check the operation of the radio altimeter by observing the

altitude indicator needle after turning on and signaling a given flight altitude.

4. After completing the check, place all switches and controls in the initial position and turn off the radio compass.

The MRP-56P Marker-Beacon Radio Receiver

1. Visually inspect the condition of the intrafuselage antenna.

2. In the cockpit, check the condition of the indicator lamps.

3. Check the operational capability of the MRP-56P with the aid of a buzzer or with a marker beacon simulator.

After completing the check, turn off the marker-beacon radio receiver.

[p 213]

The Range Only Radar

1. Check the outward appearance of the antenna fairing.

2. In the cockpit, check the outward appearance and fastening of the VD-1 range indicator, MODE switch, signal lamps, and the DROP TARGET button.

3. Check the operation of the range only radar by locking on and dropping a target (the operational capability check of the range only radar is conducted together with armament specialists).

After completing the check, place all switches and controls in the initial position and turn off the range only radar set.

The SRO-1 Responder

1. Make sure that the power to the detonator circuit is turned off.

2. Check the mounting and intactness of the antenna on the fuselage.

3. In the cockpit, check the outward appearance and fastening of

the code board, the DETONATE button, and safe-locking of the DETONATE BUTTON cover.

4. Check operational capability by signals from a ground station or with any simulator buzzer (check coding by both light and audio signals).

After completing the check, place all switches and selectors in their initial position and turn off the responder.

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Chapter VIII

Scheduled Maintenance Work

Regulation maintenance of radio equipment is performed on maintenance days every 7-10 days, every 30 days plus or minus 5 days, and every 3 months plus or minus 10 days; after every 50 hours plus or minus 5 hours of flying time and after every 100 hours plus or minus 10 hours of flying time.

Maintenance Performed on Maintenance Days

	Maintenance to be Performed	Each 7-10 Days	30 ±5 Days	3 Months ±10 Days
1	Check braided shielding of cables, polychlorovinyl sheath insulation of feeders, and connections and bonding of cables and units		+*	
2	Check mounting and damping of units			+
3	Check in helmet headset (pressurized helmet):			
	-- DC resistance and average speech intensity of laryngophones			+
	-- DC resistance and absence of blasting (overloading) of earphones			+
	-- Condition of wiring and serviceability of leads in helmet headset jack; check amount of force required to unplug jack			+
4	Check range only radar for:			
	-- range calibration with aid of UKKM-1 instrument		+	
	-- velocity calibration		+	
	-- dangerous and effective range calibration		+	

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Preflight Maintenance Based on Flight Time

	Maintenance to be Performed	Maintenance Periods Based on Flight Time After Each 50 ±5 Hours	100 ±10 Hours
1	2	3	4
	RSIU-5G Radio Set		
1	Check antenna for mounting and intactness	+	+

*("+" indicates maintenance to be performed)

1	2	3	4
2	Remove ABV and ZU units from aircraft. In ABV unit, check wiring, components, relay, and mounting of tubes and crystals		+
3	Lubricate gears of automatic reduction units		+
4	Check condition of moisture absorbent. If necessary, regenerate its hygroscopic nature by calcining		+
5	Tune ZU unit [memory unit]		+
6	Check station modes with I Meter	+	+
7	Check accuracy of frequency selection and operation of AFC circuit	+	+
[p 216] 8	Check current in dummy antenna, percentage of modulation, and earphone voltage		+
9	Check receiver sensitivity, operation of manual volume and sensitivity controls and of noise suppressor		+
10	Check braided shielding of cables, polychlorovinyl sheath insulation of feeders, connections and bonding of cables and units, and fastening of cables and feeders	+	+
11	Check condition of plug connectors and damper panel (do not open pressurized connectors) and reinstall units in aircraft	+	+
12	Check tightness of sleeve nuts of cable and feeder connectors, fastening of units and cushioning of ABV unit	+	+
13	Check operational capability of radio set on aircraft	+	+
14	Check ventillation system in aircraft	+	+
15	On aircraft or on bench, check dummy antenna current, percentage of modulation of transmitter and sensitivity of receiver	+	

1	2	3	4
	ARK-10 Radio Compass		
1	Check condition of antenna lead and its fastening to terminal A.	+	+
2	Check condition of cables and feeders, feeder equivalents, bonding wires, and fastening of cables, feeders, and equivalents.	+	+
3	Remove following radio compass units from aircraft: receiver, control panel, antenna amplifier, power supply, loop, and UAP-1 switch.		+
4	In receiver:		
	-- check wiring, components, mounting of crystals and tubes on panels, crystal meters, and condition of foil in wiring strips.		+
	-- check contacts of SUB-BAND switch.		+
	-- check contacts of circuits and of drum switch springs, and check for presence of gap between contact springs and detachable strip.		+
	-- clean drum switch circuit contacts with alcohol.		+
	-- lubricate friction points of drum switch with TsIATIM-201 lubricant.		+
5	Blow dust off power unit with compressed air, and check wiring, components, fastening of voltage regulator, and condition of wiring-strip foil. Check voltage regulation.		+
6	In the loop unit:		
	-- check wiring, components and component mounting.		+
	-- clean commutator and brushes with alcohol		+
	-- lubricate motor reduction unit with thin film of OKB-122-4 lubricant.		+
	-- lubricate bearing with OKB-122-4 lubricant.		+
	-- remove old lubricant from radio deviation compensator components and apply TsIATIM-201 lubricant.		+

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1	2	3	4
7	In control panel: -- check circuitry, components and component mounting; wiring for clearance from moving parts; and condition of contacts of selector and terminal switches. If burnt or bent contacts are discovered, change them.		+
	-- lubricate motor reduction unit (worm gear) with TsIATIM-201 lubricant.		+
	-- lubricate selsyn drive gear and gears meshing with it with OKB-122-4 lubricant.		+
8	In antenna amplifier and UAP-1 universal automatic switch, check circuitry, components, and component mounting.		+
9	On the monitor bench, check:		
	-- resistance of thermostat heating elements.		+
	-- receiver sensitivity.		+
	-- receiver passband.		+
	-- sensitivity limit of radio compass for homing and bearing.		+
	-- automatic scan rate.		+
	-- calibration accuracy.		+
	-- operation of thermorelay.		+
	-- accuracy of repetitive tuning and tuning time of automatic preset frequency tuning device.		+
	-- operational capability of radio compass and UAP-1 switch.		+
10	Check condition of pins and receptacles of cables, feeders, and units (do not open pressurized connectors). Install units on aircraft.		+
11	Check tightness of cable sleeve nuts and feeder connectors, and cushioning and mounting of units.	+	+
12	Check operational capability to extent of preliminary check.	+	+
13	On aircraft or monitor bench, check:		
	-- receiver sensitivity.	+	
	-- sensitivity limit for homing and bearing.	+	

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[p 219]

1	2	3	4
	-- accuracy of dial calibration and of repetitive tuning.	+	
	-- tuning time of automatic preset frequencey tuning device.	+	
	-- resistance of thermostat heating elements.	+	
	<u>RV-UM Radio Altimeter</u>		
1	Check antenna for mounting and intactness.	+	+
2	Check condition and fastening of cables and feeders and bonding of cables and units.	+	+
3	Remove from aircraft radio altimeter transceiver and altitude indicator. Check circuitry, components, and mounting of tubes on panels.		+
4	On the monitor bench, check:		
	-- modulation bandwidth and mid-frequency of transmitter.		+
	-- amplitude modulation suppression.		+
	-- radio altimeter calibration.		+
	-- over-all radio altimeter sensitivity.		+
	-- altitude indicator blocking sensitivity.		+
	-- preset flight altitude signal accuracy.		+
5	Check condition of pins and receptacles of cable connectors, feeders, and units. Reinstall units in aircraft.		+
6	Check fastenings and cushioning of units and tightness of cable and feeder connector coupling rings.	+	+
7	On aircraft, check:		
	-- radio altimeter calibration.	+	
	-- over-all radio altimeter sensitivity.	+	
	-- altitude indicator blocking sensitivity.	+	
	-- preset flight altitude signal accuracy.	+	

1	2	3	4
[p 220] 8	On aircraft, check operational capability of radio altimeter to extent of preliminary check.	+	+
	<u>MRP-56P Radio Receiver</u>		
1.	Check antenna fairing for mounting and intactness.	+	+
2	Check condition and fastening of cables and feeders and bonding of cables and units.	+	+
3	Remove receiver and signal unit from aircraft.		
	Check circuitry, components, relay, and mounting of tubes on panels. Clean relay contacts with alcohol.		+
4	On monitor bench, check:		
	-- receiver frequency.		+
	-- sensitivity (1.5-3 mv).		+
	-- receiver relay closing current (not more than 7 ma) and opening current (not less than 4 ma).		+
	-- proper operation of signal unit relay.		+
5	Check condition of connectors of cables and feeders (do not open pressurized connectors). Reinstall receiver and signal unit on aircraft.		+
6	Check tightness of connector couplers of cables and feeders and cushioning and fastening of units.	+	+
7	Check operational capability of receiver to extent of preliminary check.	+	+
8	On aircraft or monitor bench, check receiver frequency, and determine sensitivity of receiver with simulator antenna 1-3 meters from receiver.	+	

1	2	3	4
[p 221]	Range Only Radar		
1	Check antenna and fairing for mounting and intactness.	+	+
2	Remove units 2, 3, 4, 5, 6, 8 from aircraft.		+
3	Open units and check circuitry, components, and mounting of tubes on panels Clean commutator and blow off electric motor of transceiver with compressed air.		+
4	Check time it takes to turn on high voltage.	+	+
5	Check operation of AFC circuit.		+
6.	Check scanning range in A and B modes.		+
7	Check operation of AGC for noise.	+	+
8	Check lock-on circuit sensitivity.	+	+
[p 222] 9	Check transmitter frequency.		+
10	Check lock-on sensitivity of receiver.		+
11	Check pulse function of AGC.		+
12	Check unit 2 and waveguide channel for hermetic seal (pressure in unit 2 should be checked after each opening of unit).		+
13	Check condition of pins and receptacles of connectors (do not open pressurized connectors) and cushioning of panel. Reinstall units in aircraft.		+
14	On aircraft, check shielding and protective sheathing of cables, bonding straps, tightness of cable connector couplers, and		

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1	2	3	4
	mounting and cushioning of units.	+	+
15	Check range calibration in A and B modes.	+	+
16	Check velocity calibration.	+	+
17	Check calibration and operation of dangerous- and effective-range circuits.	+	+
18	On aircraft, check operational capability of range only radar to extent of preliminary check.	+	+
	<u>SRO-1 Responder</u>		
1	Check antenna for mounting and intactness.	+	+
2	Check cable shielding, bonding straps of cables and units, and fastening of cables and feeders. Inspect electrical wiring of detonator circuit, and check voltage at detonator plug pins.	+	+
3	Remove responder from aircraft. Check circuitry, components, and mounting of tubes on panels.		+
[p 223] 4	Clean surface of rocking mechanism and lubricate rod roller.		+
5	Blow out inner chamber of converter. Clean commutator brush assemblies and lubricate open ball bearings.		+
6	On monitor bench, check transceiver for:		
	-- frequency bands.		+
	-- power output.		+
	-- pulse duration.		+
	-- proper signal coding.		+
	-- receiver sensitivity.		+

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1	2	3	4
7	Check condition of pins and receptacles of connectors (do not open pressurized connectors). Reinstall responder in aircraft.		+
8	Check tightness of connector couplers of cables and feeders.	+	+
9	Check mounting and cushioning of units.	+	+
10	On aircraft, check:		
	-- frequency band.	+	+
	-- proper signal coding.	+	+
	-- receiver sensitivity.	+	+
11	Check detonator circuit.	+	+
12	Check operation of responder to extent of preliminary check.	+	+

Technical Servicing of Radio Equipment During Storage of Aircraft

Every 10 ± 2 days, perform maintenance as indicated in the "Preflight Check" section.

Every 50 ± 5 days, perform maintenance as indicated in the "Preliminary Check" section.

PART THREE

INSTRUMENTATION

SECRET

Chapter I

GENERAL INFORMATION ON INSTRUMENTATION

The instrumentation on an aircraft ensures the performance of flights during the day and night under difficult meteorological condition, at any altitudes to the practical ceiling, and solves the following matters: [P-225]

a) it orients the aircraft in space and along a route;

b) it controls the operations of the power plant, the rocket gun armaments, and the radio equipment;

v) it controls and provides the necessary conditions in the cockpit for normal performance by the pilot.

The instrumentation consists of the

a) flight-navigation instruments

b) engine operation control instruments

v) instruments for controlling the performance of separate assemblies and systems on the aircraft.

All the instruments are found on the instrument board center panel, figure 53, and on the left and right panels, figures 54 and 55, at points to which access for observation and control is easy.

Flight-navigation Instruments

The flight-navigation set of instruments refers to all the instruments with which the aircraft's position in space is controlled in relation to the ground, and with which flight is performed.

The flight-navigation set of instruments includes the following: [P-229]

1. KUS-2500 combination speed indicator

2. M-2.5 machmeter

3. VD-28 two-pointer altimeter

4. AGD-1 remote master attitude indicator

5. VAR-300 variometer

6. KSI course system

7. EUP-53 electric turn indicator

8. AM-10 G-meter

Engine operation control instruments

The set of instruments which controls engine operations consists of the following:

1. ITE-2 electric remote tachometer

2. TVG-11T exhaust gas thermometer

3. RTS-16A-4 fuel consumption computer

4. DIM-8T electric remote pressure gauge

Instruments for controlling individual units and systems [P-229-230]

The set of instruments which controls individual units includes the following:

1. UVPD-20 "altitude" and pressure drop indicator

2. AChHkO clock

3. SD-3 fuel pressure indicator

4. SUD-2-0.35 pressure indicator

5. 2EDM-250 electrical remote pressure gauge [P-230]

6. 2M-150 air pressure gauge

7. MV-12 pressure gauge

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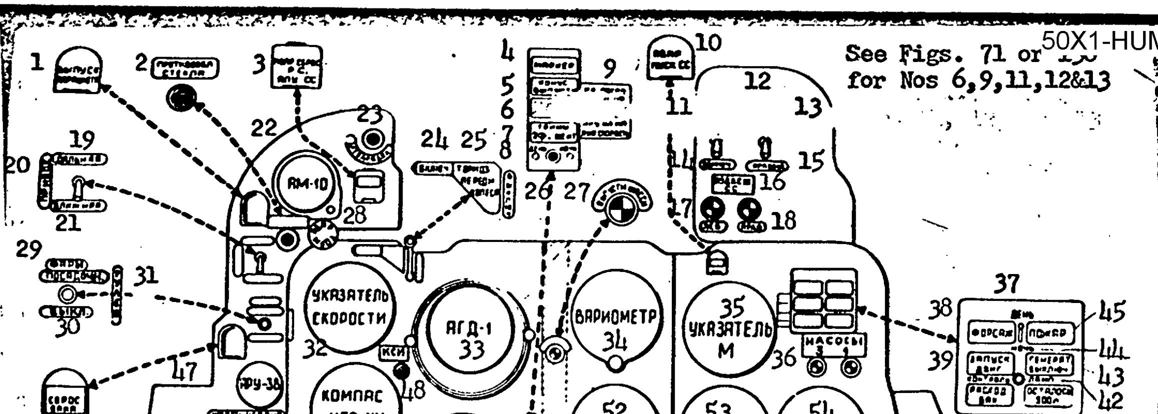

Рис. 53. Приборная доска

Fig. 53 Instrument Panel

Fig. 53 - Location of Instruments on Instrument Panel [p-226]

1. Parachute release
2. Windshield de-icer
3. Emergency jettison RS [Raketnyye snaryady -- Rockets], APU [Aviatsionnoye puskovoye ustroystvo -- Launch mechanism] an SS [Samonavodyashchiyesya snaryday -- Missiles]
4. Marker
5. Cone extended
6. Stabilization on landing
7. Trim effect neutral
8. Day (left) - night (right)
9. Light is not on during landing. Switch ARU [?Avtomaticheskaya regulirovka upravleniya -- Automatic controller?] to low speed
10. Emergency launch SS
11. Salvo
12. SS launch
13. Left
14. Single
15. Right
16. SS attached
17. Left
18. Right
19. Long range
20. Beacon
21. Short range
22. AM-10 [accelerometer]

23. Reload
24. On
25. Nose wheel brake
26. Off
27. Extend landing gear
28. Emergency brake
29. Landing lights
30. Off
31. Taxi lights
32. Air speed indicator
33. AGD-1 [Aviagorizont distantsionnyy -- Attitude indicator]
34. Vertical velocity indicator
35. Machmeter
36. Pumps
37. Day
38. Afterburner
39. Engine start
40. Drop tank
41. [Fuel] reserve, 500 liters
42. Monitor light
43. Generator off
44. Night
45. Fire
46. Tank jettison
47. ARU-3V [?Automatic controller indicating device?]

48. KSI [Kursovaya sistema istrebitelya -- Fighter course indicator system]

49. Landing gear retracted

50. UGR-4 compass [Indicator of course, magnetic bearing, radio station angles, course deviation]

51. Altimeter

52. EUP-53 [Elektricheskiy ukazatel' povorota -- Electric turn indicator]

53. Tachometer

54. Fuel flow indicator

55. IK-18 [Indikator kisloroda -- Oxygen gage]

56. ARK BPRS [Avtomaticheskiy radiokompas -- Automatic radio compass, Blizhnyaya privodnaya radiostantsiya -- Inner marker beacon]

57. UV-57 [Ukazatel' vysoty -- Altitude indicator]

58. Oil pressure gage

59. Booster

60. Utility

61. Hydraulic system

62. V-1 [Voltmeter]

63. [Landing gear] extended

64. Dangerous altitude

65. AChKhO [Aviatsionnyye chasy -- Aircraft clocks] triple-dial clock

66. UVPD [Ukazatel' "vysoty" i perepada davleniya -- Cockpit-altitude and differential-pressure indicator]

67. Temperature gage

68. 2EDM-250 [Elektricheskiy distantsionnyy manometer -- Electrical pressure gage]

69. ISA [Integriruyushchiy schetchik amper-chasov -- Ampere-hour meter]

70. Extend flaps before take-off

71. Extend landing gear

72. Heat

73. Flaps extended

74. Emergency PVD [Priyemnik vozdushnykh davleniy -- Pitot-static head]

75. Operational PVD and clocks

76. Monitor light

77. Speed brakes extended

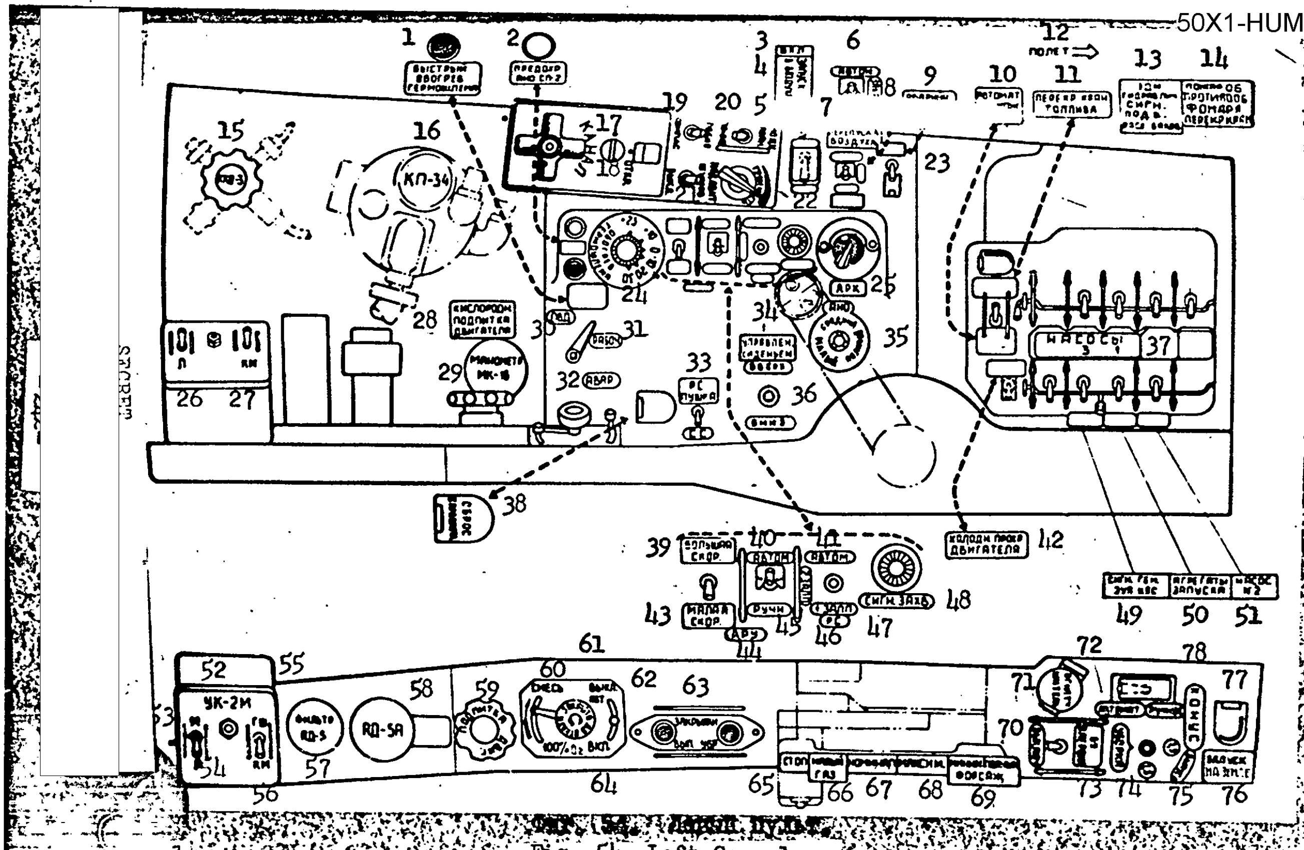

Рис. 54. Левый пульт
Fig. 54 Left Console

Fig. 54 - Left Console Instrument Arrangement [p-227]

1. Rapid helmet heating
2. SP-2 ANO [Aeronavigatsionnyye ogni -- Navigational lights] fuse
3. On
4. Air start
5. Off
6. Automatic
7. Open
8. Close
9. Emergency nozzle control
10. Automatic brakes
11. Fuel shut-off valve
12. Forward
13. EDM [Elektricheskiy distantsionnyy manometr -- Electrical pressure gage], drop-tank-attached indicator
14. Canopy de-icing shut-off valve [in case of fire]
15. KKV-3 [?Komplekt kislorodnogo ventilya? -- Oxygen valve unit]
16. KP-34 [Kislorodnyy pribor -- Oxygen apparatus]
17. Channel
18. Open
19. Radio compass
20. Power -- full (left), normal rated (right)
21. Noise suppressor (right), off (left)
22. Volume
23. Air by-pass valves

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24. Helmet heat

25. ARK [Avtomaticheskiy radiokompas -- Automatic radio compass]

26. L [Letnyy kostyum -- Flying suit]

27. KM [Kislorodnaya Maska -- Oxygen mask]

28. Engine oxygen supply

29. MK-16 [Manometr kisloroda -- Oxygen gage] gage

30. PVD [Priyemnik vozdushhogo davleniya -- Pitot-static head]

31. Operational

32. Emergency

33. RS [Raketnyye snaryady -- Rockets], Cannon, SS [Samonavodyayshiysya snaryady -- Missiles]

34. Seat adjust

35. ANO -- bright, medium, dim

36. Up -- down

37. Pumps

38. Parachute jettison

39. High speed

40. Automatic -- manual

41. Automatic

42. Engine cooling blanket(s)

43. Low speed

44. ARU [?Avtomaticheskaya regulirovka upravleniya -- Automatic controller?]

45. 2 salvo

46. RS

47. 1 salvo

48. Lock-on signal

49. Afterburner

50. Generator, EUP [Electricheskiy ukazatel' povorota -- Electric turn indicator], and KYaS [?] indicator

51. Starting units

52. Pump No 2

53. M [?Manometr -- Gage?]

54. UK-2M [Ustanovka kisloroda -- Oxygen unit]

55. L

56. Gsh [Germoshlem -- helmet]

57. KM

58. AD-5 [Avtomat davleniya -- Automatic pressure control] filter

59. AD-5A

60. Engine [oxygen] supply

61. Mixture

62. Full closed

63. Off - Automatic

64. On

65. Flaps, down (left) -- up (right)

66. [Engine] off

67. Idle

68. Normal rated

69. Maximum

70. Afterburner -- minimum/full

71. Off

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72. Fire extinguisher
73. Automatic
74. Aileron booster
75. Retract
76. Manual
77. Cone
78. Extend
79. Ground start

авар. перекл. преобр.

авар. сброс Р.С. бака АПУ
авар. пуск СС

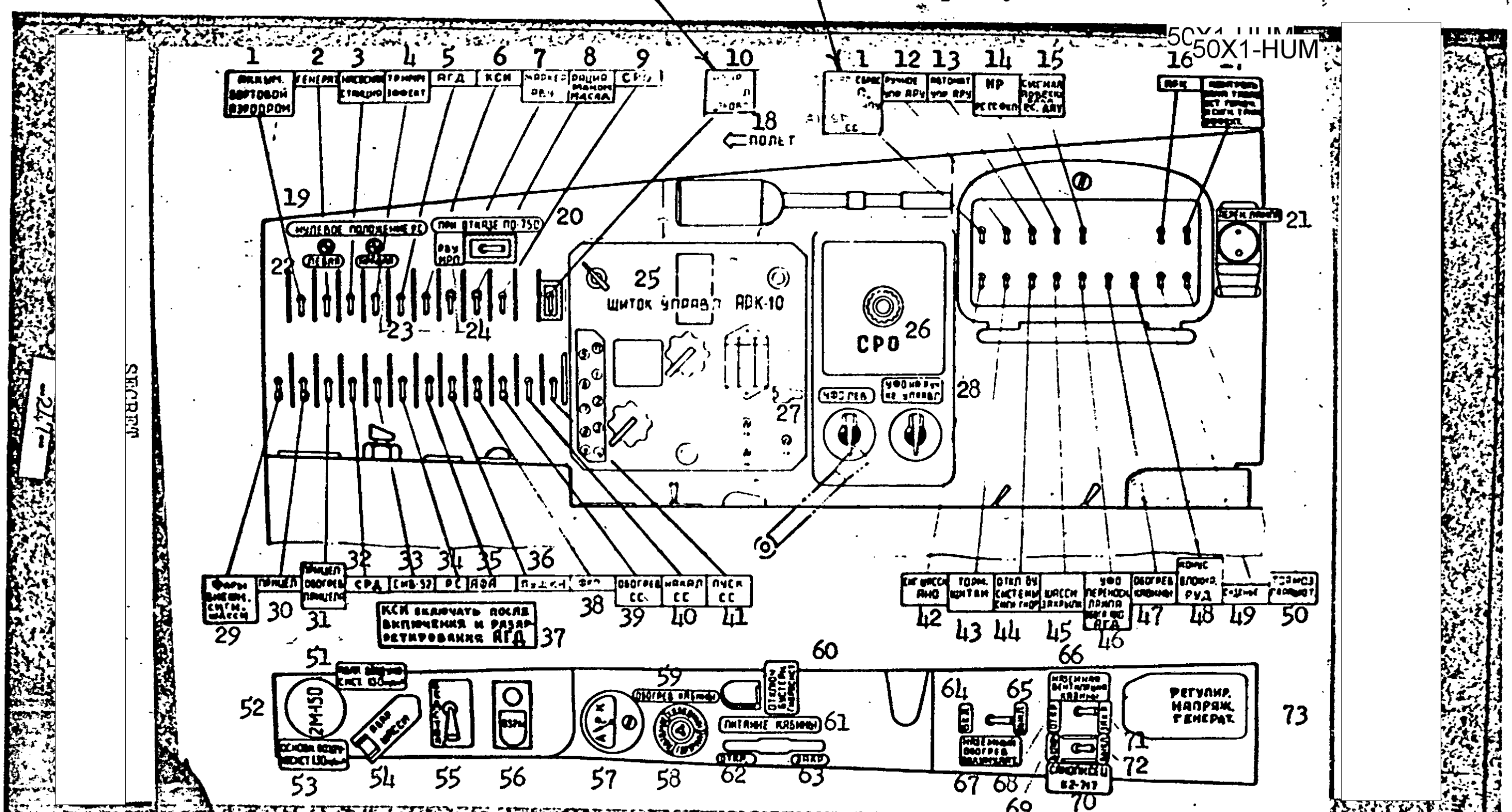


Fig. 55 Right Console

Фиг. 55. Правый пульт

Fig. 55- Right Console Instrument Arrangement

1. Battery -- aircraft, external
2. Generator
3. Pump unit
4. Trim effect
5. AGD [Aviagorizont distantsionnyy -- Attitude indicator]
6. KSI [Kursovaya sistema istrebitelya-- Fighter course indicating system]
7. RVU [Radiovysometer -- Radio altimeter] marker
8. Oil pressure gage
9. SRO [Stantsiya radiolokatsionnogo otvetchika -- Responder radar]
10. Emergency converter switch
11. Emergency jettison RS[raketnyye snaryady -- rockets], wing tank, APU [Aviatsionnoye puskovoye ustroystvo -- launch mechanism] and emergency launch SS [samonavodyashchiyesya snaryady -- missiles]
12. Manual control ARU [?Avtomaticheskaya regulirovka upravleniya? -- Automatic controller
13. Automatic control ARU
14. NR [NR-30 cannon], RS, SS, and FKR [Fotokinopulemet -- gun camera]
15. Wing tank, RS, APU indicator light
16. ARK [Avtomaticheskiy radiokompas -- automatic radio compass]
17. Light register monitor, fuel reserve, trim effect signal
18. Forward
19. Null position of RS
20. [Switch on] in event of PO-750 converter failure
21. Utility light

Fig. 138 (cont'd)

22. Left

23. Right

24. RVU MRP [Markernoye radiopriyemnik — Marker beacon radio receiver]

25. ARK-10 control panel

26. SRO

27. UFO [Ul'trafioletovoye osveshcheniye — Ultraviolet lighting] left

28. UFO on control stick

29. External landing gear indicator lights

30. Sight

31. Sight warm-up

32. SRD [Stantsiya radiodal'nomera — range-only radar]

33. SIV-52 [Signalizator infrakrasnogo vizira — Infrared viewer]

34. RS

35. AFA [Aerofotoapparat — Aerial camera]

36. Cannon

37. Turn on KSI after switching on and uncaging AGD

38. FKP

39. SS warm-up

40. SS filament

41. SS launch

42. Landing gear and ANO [Aeronavigatsionnyye ogni — Navigational lights] indicator light

43. Speed brakes

44. Booster system and hydraulic indicator switch

45. Landing gear, flaps

46. UFO, utility light, heating of KKO [Komplekt kislorodnogo oborudovaniya — Oxygen equipment unit] and AGD

Fig. 138 (cont'd)

47. Cabin heating

48. Cone-RUD [Ruchnoye upravleniye dvigatelya — Throttle] interlock gear

49. Seat

50. Parabrake

51. Emergency air system - 130 kg/cm^2

52. 2M-150 [air pressure gage]

53. Utility air system - 130 kg/cm^2

54. Emergency landing gear extension

55. Distress

56. Destruct

57. [Cabin temperature control dial] automatic, hot, cold

58. ARK

59. Cabin heat

60. Hydraulic booster system cut-off

61. Cabin air

62. Open

63. Close

64. On

65. Off

66. Cabin ground ventilation

67. Battery ground heating

68. Open

69. On

70. K2-717 recorder

71. Close

72. Off

73. Generator voltage regulator

Chapter II

FLIGHT-NAVIGATION INSTRUMENTS

[P-230]

DUAS-8M and TP-156M air pressure system

All the flight-navigation instruments on an aircraft are part of a general system of static pressure from the DUAS-8M pressure head and of absolute pressure from the DUAS-8M and TP-156M air pressure chambers (fig. 56)

The DUAS-8M chamber is mounted on a rod in the forepart of the nose section and serves for the perception of absolute pressure developed during aircraft movement and for separate perception of static pressure.

The TP-156M chamber is mounted on the top right of the fuselage, between frames 4 and 5, and is used for emergency only for the dynamic system.

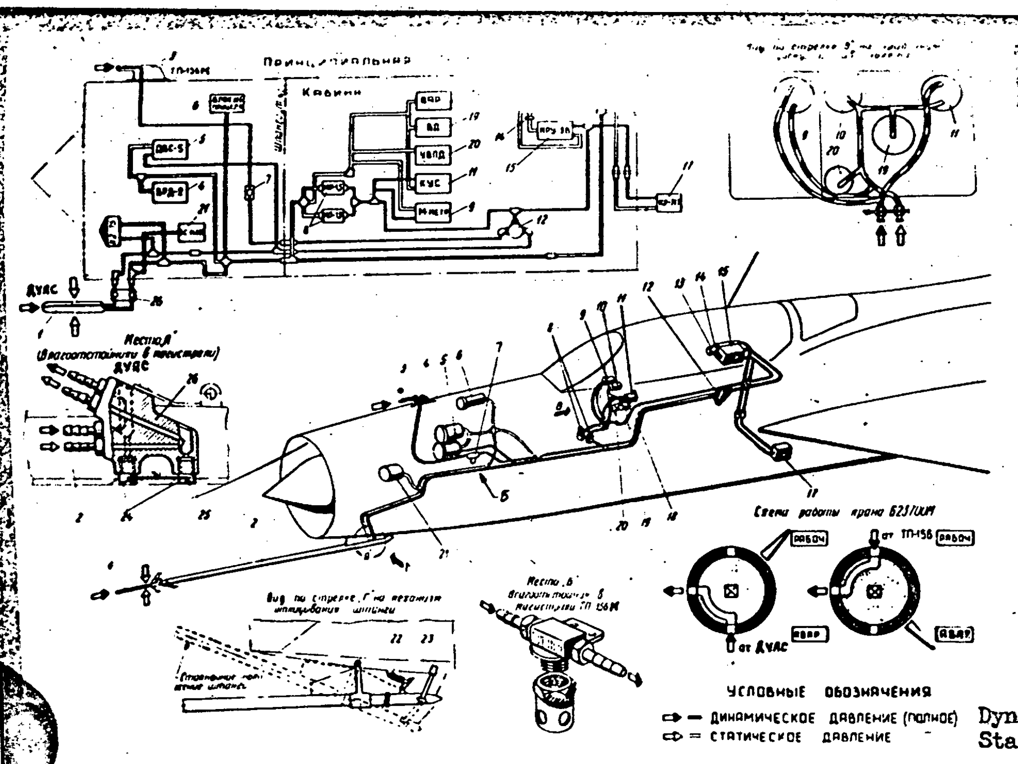
If the DUAS-8M pressure head breaks down, absolute pressure flow is provided by the TP-156M chamber by switching the valve on the left side of the cockpit from PVD "Raboch." (working) position to PVD "Avar." (emergency) position.

Drains are installed in the static and absolute pressure lines to prevent moisture from seeping into the instruments.

Fig. 56 -- Aneroid-diaphragm Instruments Supply System [P-232]

1. DUAS-8M Pressure Head
2. Rod
3. TP-156M Pressure Head
4. VRD-2A Permissible Range Computer (SRD assembly)

TP-156M Main Cockpit



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Фиг. 56. Схема питания анероидно-мембранных приборов.

Fig. 56 - Aneroid-diaphragm Instruments Supply System

5. DVS-5 Air Speed Transmitter (SRD assembly)

6. Unit No 6 (ASP assembly)

7. TP-156M Pipeline Moisture Trap

8. MP-1.5 and MP-1.9 Transmitter

9. Machmeter

10. Variometer /

11. Speed Indicator

12. 623700M Valve for Dynamic Pressure Transfer from DUAS-8M Primary Pressure Chamber to TP-156M Emergency System

13. Cabin Pressure Control of ARD-57 Unit

14. Separable Sleeve connection for Ground Testing of ARU-3V Automatic System

15. Resolution Unit of ARU-3V Automatic System

16. [Number blacked out in listing; does not appear in fig. 56]

17. K2-717 Barospeedograph

18. Instrument Board

19. Altimeter [P-232]

20. UVPD ["Altitude" and Pressure Drop Indicator]

21. VS-14500 Altitude Indicator

22. Articulated Cantilever

23. Adjusting Screw

24. Trap Plug

25. Safetying Lock Wire

26. DUAS-8M Pipeline Moisture Trap

In order that the rod of the DUAS-8M pressure head does not break in an upright position, the rod is a tilting type rod. After the nut is unscrewed, the rod is easily raised upwards and adjusted in this position with the "articulated cantilever."

A separable sleeve connection is provided in the static pressure line for ground testing of the ARU-3V automatic system unit.

To prevent the DUAS-8M and TP-156M systems from freezing, heating elements have been installed.

Leak Test of DUAS-8M and TP-156M Systems

The static and absolute pressure systems of the DUAS-8M pressure head are checked for leakage with the KPU [kontrol'no-proverochnoye ustroystvo (?) - test and checkout unit], and the test requires:

1. The shut-off valve on the left panel must be in "Raboch." (Operating) position.

2. Connect the KPU to the static chamber of the DUAS-8M and gradually develop for at least two minutes in the conduit a vacuum that corresponds to the reading on the altimeter at 5,000 meters, and then shut off the valve. After one minute passes, the large pointer should not move more than 100 meters; then gently release the vacuum in the static system.

Connect the KPU to the dynamic chamber of DUAS-8M pressure head and gradually develop in the conduit pressures corresponding to 1,000 km/hr of indicated speed on speed indicator, and then switch the valve to KPU. If the speed indicator needle does not drop by more than 25 km/hr for one minute, the conduit is considered air-tight. Gently release pressure in the dynamic chamber.

To check if dynamic conduit of the TP-156M pressure head is air-tight, the change-over valve must be in "Avar" (emergency) position. Connect the KPU to the TP-156M, build up pressure corresponding to 1000km/hr on velocity indicator, and switch the valve to the KPU. The conduit is considered airtight if the needle on the indicated speed indicator does not drop more than 25 km/hr. Gradually release the pressure in the dynamic system. [P-234]

When the test is completed, place the valve handle in "Raboch" [Operation) position, and safety it with wire.

KUS-2500 Combination Speedometer

The KUS-2500 combination speedometer (fig. 57) is designed to measure the indicated speed of an aircraft within a range of 200-1600 km/hr and its true speed within a range of 400-2500 km/hr.

During operation, check the following every 50 hours:

1. Airtightness of housing
2. Airtightness of dynamic system
3. Indicator error at normal temperature

Determine if instrument housing is airtight by means of the pointer of the true speed indicator. Connect sleeve connection "S" with vacuum pump, build up on the instrument dial a vaccuum corresponding to a speed of 1600 km/hr, and meanwhile, leave dynamic sleeve connection "D" open. Then shut off vacuum source with the valve, squeeze the hose of connection "S" and watch for one minute for changes on the meter dial. The instrument dial pointer should not drop more than 40 km/hr.

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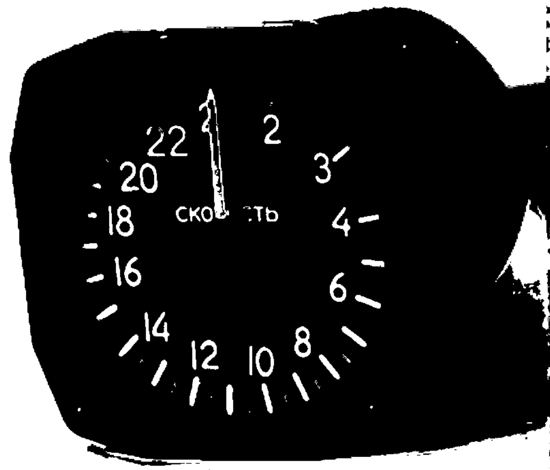
[redacted]

Speed



Фиг. 57. Указатель скорости КУС 2500
Fig. 57 KUS-2500 Speed Indicator

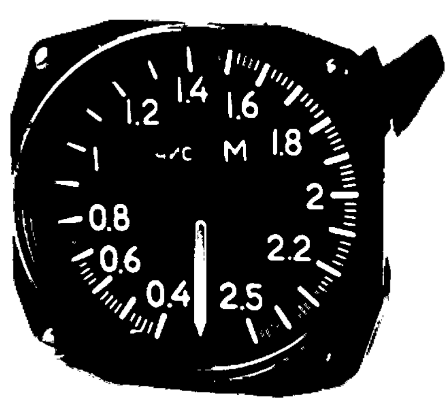


Fig. 58 Machmeter

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The airtightness of the dynamic system of the instrument is ascertained by means of the indicated speed dial pointer. Connect the connection "D" with the pressure source, build up with the mercury manometer a pressure corresponding to 1650 km/hr at altitude of zero km [sea level]. Shut off the pressure source with the valve, squeeze the hose of connection "D" and watch for one minute for changes in the instrument reading. The pointer on the instrument dial should not drop. [P-235]

Instrument error is ascertained as follows:

Join connection "S" with vacuum source and connection "D" with pressure source.

To ascertain indicator error of indicated speed, develop with the mercury manometer a pressure in the dynamic system that corresponds to the scale readings being checked.

The extent of reading error on each checked reading is calculated as the difference between the recordings of the examined instrument and the mercury manometer.

To ascertain indicator error of true speed at zero km altitude, build up pressure of 760 mm Hg with the mercury barometer in the static system of the instrument, and with the mercury manometer a pressure corresponding to the scale marks being checked.

The extent of reading error is calculated as the difference between the recordings of the examined instrument and the mercury manometer.

The extent of indicator error of each check reading is calculated as the difference between the reading on the examined instrument and the reading on the mercury pressure gage.

v) To ascertain error of actual speed recordings at a height of 0 km [sea level], develop within the static system of the instrument [P-236]

50X1-HUM

a barometric pressure of 760 mm Hg, and within the dynamic system a mercury gage pressure that corresponds to the scale readings being checked.

The extent of indicator error is calculated as the difference between the reading on the examined instrument and the mercury pressure gage.

To ascertain the true speed indicator errors at other altitudes, with the mercury barometer develop in the static system a vacuum that corresponds to that at altitudes of 4, 8, 12, 16, 20, and 25 km; develop in the dynamic system for each altitude that is being checked a pressure with the mercury manometer that corresponds to the speeds shown in the calibration table of the certifications for the instrument.

The extent of indicator error is calculated as the difference between the reading on the instrument being tested and the reference value found in the calibration table.

In performing the test, the following conditions must be observed:

a) test must be performed at a normal temperature of +20° C, ± 5° C permissible deviation.

b) position of instrument must conform to position during operations;

v) testing vibration range with load from vibration, 0.1g to 0.3g

COMMENT: 1. At an altitude of zero kilometers [sea level], readings on the calibrated scale markings must be made with rising and subsiding values of the measured quantity with a hold of at least 15 minutes on the last calibrated scale marking. [P-238]

2. Pressure and vacuum for each scale reading being checked must be maintained for at least one minute.
3. The test vibration may be shut off at the moment reading is taken.

Machmeter

The M-2.5 Machmeter (shown in figure 58) is designed for measuring the relation of the true flight speed to the speed of sound, i.e., the mach number.

The instrument measures the mach number from 0.4 to 2.5 at altitudes of 0-25 km.

During operation, the M-2.5 instrument must be checked every 50 hours:

1. To ascertain if instrument casing is airtight
2. To ascertain if dynamic system is airtight
3. To ascertain instrument indicator error.

The check for airtightness of the instrument housing is made as follows: join connection "S" to vacuum pump and develop on instrument scale a vacuum that corresponds to a mach number of 1 (with dynamic connector open); then shut off vacuum source, squeeze hose of connector "S", and watch readings on instrument for one minute. The pointer on the meter should not move during this one minute more than one scale index mark. P-239

The dynamic system is checked for leakages as follows: Pipe fitting "D" is connected with pressure source. Build up in dynamic system a pressure corresponding to mach number of 1.6 at an altitude of zero

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kilometers [sea level]; shut off pressure and squeeze the hose of the connecting pipe.

The needle on the scale is not supposed to move for one minute.

Indicator errors of the instrument are ascertained as follows:

a) Pipe "S" is connected with vacuum source, and Pipe "D", with with pressure source;

b) To ascertain indicator error at zero kilometer altitude, develop in the static system a pressure on the mercury barometer of 760 mm Hg, and in the dynamic system, a pressure on the mercury manometer that corresponds to the scale indexes that are being checked. The extent of error is calculated as the difference between the readings of the instrument being tested and the reading on the mercury manometer.

v) To ascertain instrument indicator error at other altitudes, develop in the static system a vacuum on the mercury barometer corresponding to altitudes of 4,8, 12, 20, and 25 kilometers, and in the dynamic system develop pressures corresponding to calibrated scale markings.

Calculate extent of error as the difference between the reading on the instrument being checked and the value of the measured quantity in the calibration table. [P-240]

On the right panel of the instrument board, there is an instrument indicator correction table for altitudes above 13 kilometers and for mach numbers M= 1.8 and M maximum.

Corrections are given from actual value of mach number according to altitudes.

M true = M instrument +/±

Below is a standard table:

M actual and km	1.8	Maximum
12	-0.01	-0.015
14	-0.02	-0.04
16	-0.02	-0.03
18	-0.01	
and so forth		

Before a new machmeter is installed on the aircraft:

1. Take corrected readings of manometer for altitudes and mach numbers. Enter the obtained corrections in the table of the certifications (on p 4) for the instrument; and for mach numbers M-1.8 and M maximum, fill out, according to above table, on a separate sheet of Vatman paper and place into a cassette mounted on the instrument board. Be sure to write the number of the instrument on reverse side of table.

2. Use the corrections obtained to compute actual value of mach number during operation of the aircraft. P-241

COMMENT: During normal temperature, instrument readings correction does not exceed values shown in table No 1 of the certificate for the mach-meter.

In performing the above tests, the following conditions should be observed:

a) normal temperature: plus 20° C, with deviation of ±5°C;

b) normal position of instrument;

c) testing vibration range with load from vibration, 0.1g to 0.3g

COMMENT: 1. At an altitude of zero kilometers readings on the calibrated scale markings must be made with rising and subsiding values of the measured quantity with a hold of at least 15 minutes on the last calibrated scale marking

2. Keep pressure or vacuum for at least one minute on every calibrated scale marking.

3. Test vibration may be disconnected during moment that reading is taken.

VD-28 Two-pointer Altimeter [P-242]

(Fig. 59)

The VD-28 two-pointer altimeter is designed for measuring the altitude of the aircraft within a measurement range of 0 to 28 km. During operation, the following tests should be made of the instrument every 50 hours:

1. Airtightness of instrument housing
2. Error of instrument indication

Determine airtightness of instrument by developing in the instrument a vacuum corresponding to an altitude of 5,000 meters.

When the indicated vacuum is reached, shut off the vacuum pump with a valve, squeeze the hose of the protruded connecting tube of the instrument, and observe for one minute for a vacuum reduction in the housing by the drop of the large pointer on the instrument. The pointer is not supposed to drop more than 100 meters for one minute.

Determine instrument indicator error as follows:

a) Connect instrument with vacuum source.

b) Build up vacuum in instrument housing equivalent to 760 mm Hg

V) Set pointers with rack and pinion handle at zero mark, then develop vacuum corresponding to value of dial scale marks being checked.

Calculate extent of indicator error as difference between readings on instrument being tested and mercury barometer. [P-244]

The following conditions must be observed when test is performed:

a) Position of instrument must correspond to its position during operation.

b) Testing vibration range with load from vibration, 0.1g to 0.3g

COMMENT: 1. Perform test at normal temperature of +20°C, with deviation of $\pm$ 5°

2. Take readings of meter scale marks at rising and declining values of measured quantity.

3. Vacuum must be maintained on the last scale marking for at least 15 minutes.

4. Test vibration may be shut off at the moment reading is taken.

VAR-300 Variometer

The VAR-300 Variometer (shown in figure 60) is designed for measuring the vertical component of speed during the climb and descent of the aircraft.

During operation, after every 50 hours of flight: [P-245]

a) Check instrument housing for airtightness

b) Ascertain indicator error

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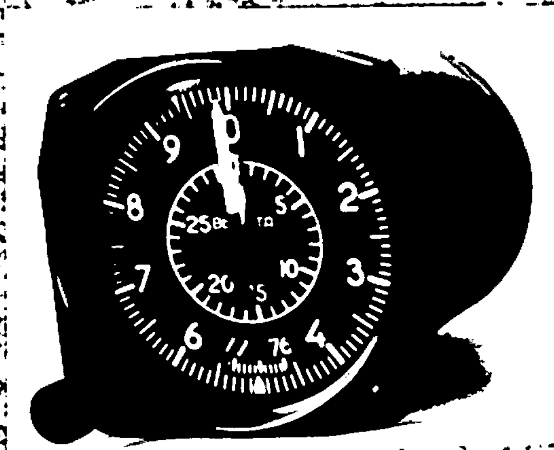
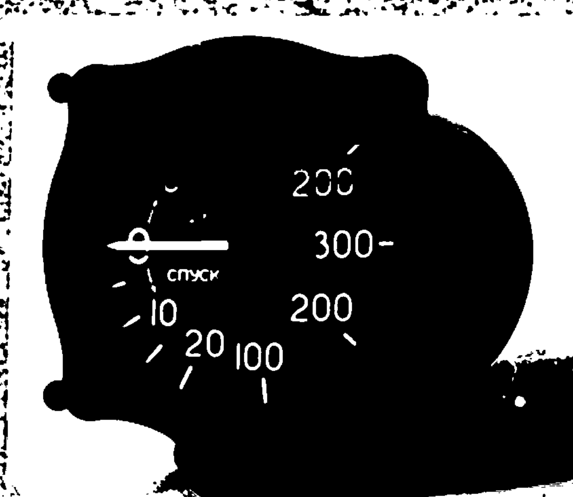


Фиг. 59
Высотомер ВД-28

Fig. 59
Altimeter VD-28

Climb



Descend

Фиг. 60
Вариометр ВАР-300

Fig. 60

Variometer VAR-300

Determine airtightness of instrument housing by water pressure gauge. Connect protruding tube of instrument with vacuum source; develop a vacuum equal to 700 mm on/ the water column and maintain such vacuum for one minute. Then squeeze the hose and watch for changes in readings of water pressure gauge for period of one minute. The drop is not supposed to exceed 3 mm ~~in~~ on the water column.

Calculate indicator error in following manner. When test is started, set instrument pointer in zero position by turning adjusting screw. Then develop vacuum with mercury barometer equal to 5000 m. With an inclined-tube alcohol manometer, find the indexes being checked first on the "climb" scale, then on the "descent" scale. The reading must be made within an altitude range of 5000-6000 meters.

The extent of instrument indicator error is calculated as the difference between the readings on the instrument being tested and the inclined-tube alcohol manometer.

The following conditions must be observed when tests are performed:

a) Test must be made at normal temperature of $+20^{\circ}$, with deviation of $\pm 5^{\circ}C$

b) Testing vibration range 0.1g to 0.3g

c) Position of instrument must correspond to its position during flight.

COMMENT: 1. Test vibration may be turned off during moment reading is made. [P-246]

2. Mercury barometer and inclined-tube alcohol manometer must be in normal conditions and free from any vibration.

AGD-1 Remote Master Attitude Indicator

The AGD-1 attitude indicator is a system which renders the angles of bank and pitch in conformance with the electric signals sent by a remotely-located vertical gyro (gyrotransmitter).

The master attitude indicator outfit consists of a gyrotransmitter and a horizon indicator (shown in figure 61)

For normal performance of the AGD-1 master attitude indicator, the following are mounted on the aircraft:

a) PT-500Ts converter to supply three-phase 36-volt and 400-cycle a.c.

b) VK-53RB correction switch for switching off lateral correction during turns.

The AGD-1 is supplied 27-voltage d.c. from the aircraft network.

The mounting arrangement and the overall diagram of the A6D-1 of remote master attitude indicator is shown in figure 62.

The gyrotransmitter is mounted in a housing on the left side (in the radio equipment hatch between cross members Nos 5 and 6 in a strictly horizontal position ($\pm 1^{\circ}$ deviation permitted) and parallel with the longitudinal axis of the aircraft (permissible azimuth deviation $\pm 15^{\circ}$) on a special panel on which marks or graduation lines were made after installation.

The PT-500Ts converter is mounted in front of the gyrotransmitter on the right side between cross members Nos 1 and 2. [P-248]

The horizon indicator is mounted on the central buffer section of the instrument board in a way that its front face is parallel with the lateral axis of the aircraft.

The VK-53RB correction switch is mounted on the instrument board.

CSDB-3/655,648

[redacted] 50X1-HUM

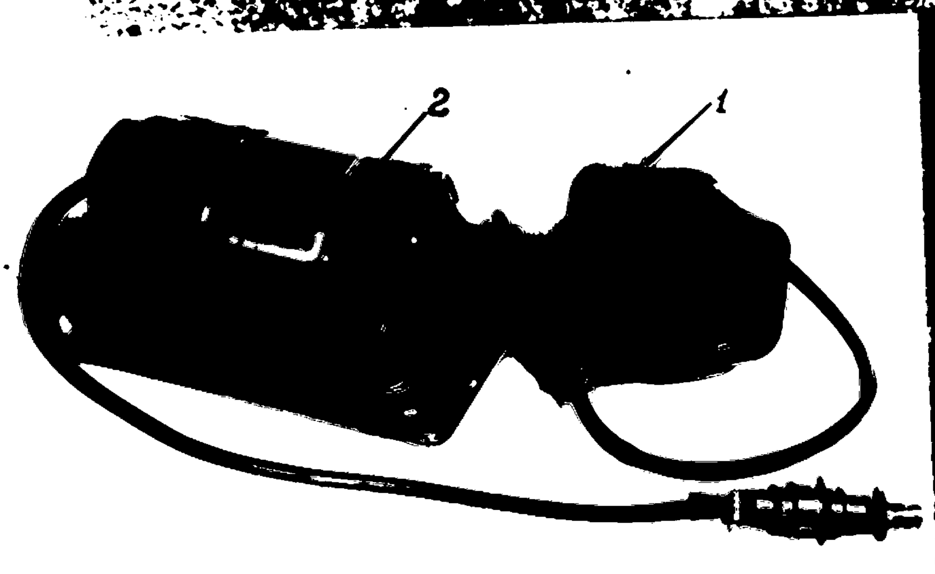


Fig. 61. AGD-1 Components

Indicator AGD-1

Gyrotransmitter

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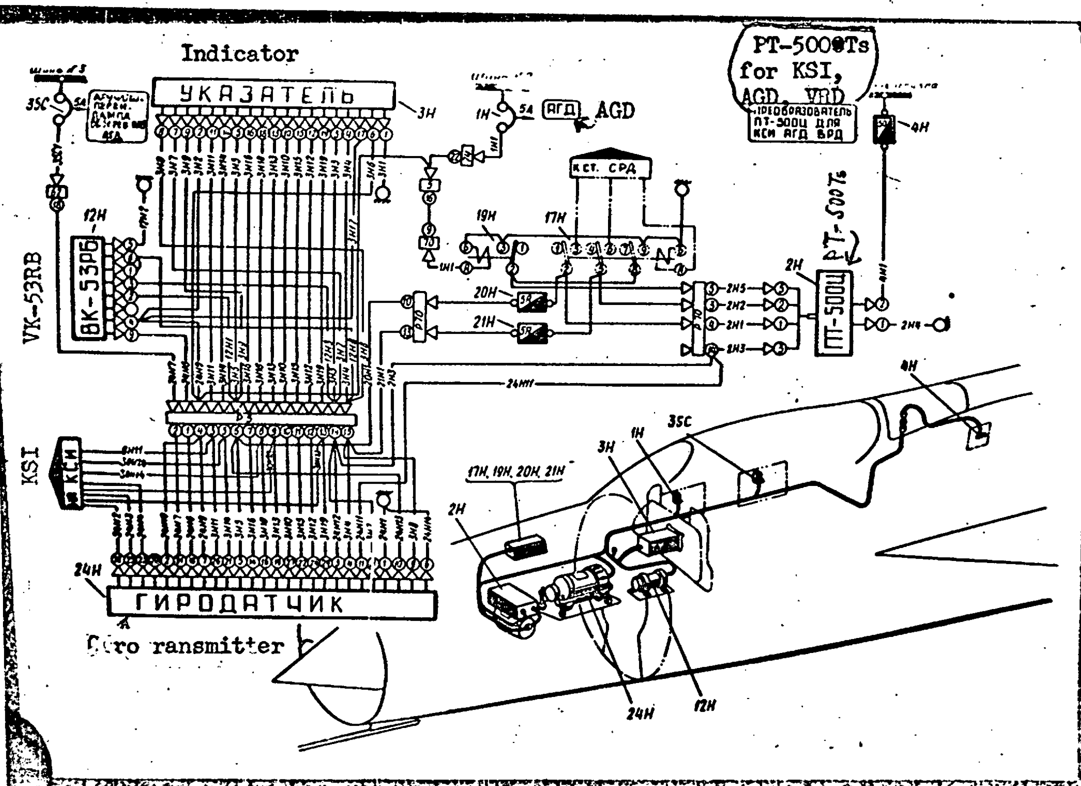
[redacted] 50X1-HUM

50X1-HUM

50X1-HUM



Фиг. 62. Принципиально-монтажная схема АГД-1.

Fig. 62 Main assembly arrangement of AGD-1

During the pre-flight preparation, check

a) caging process

b) efficiency of AGD-1 set

Perform test as follows:

a) Feed 27-volt current from ground installation into aircraft system;

b) Engage switch "Akkum. bortovoy aerodrom." (Battery, aircraft airport)

c) Engage AZS "AGD" and AZS "ARUFO", portable lamp, heater KKO-3, signal AGD.

With this, the PT-500Ts is supposed to start.

The AGD-1 is actuated by the gyrotransmitter caging-uncaging cycle during which the signal lamp on the horizon indicator is supposed to be on. After caging, the lamp is supposed to go off. Caging time should not exceed 15 seconds. [P-248]

COMMENT: 1. Normal actuation of the AGD-1 outfit is ensured at ground pitch and bank angles of aircraft up to $\pm 4^{o}$

2. AGD-1 is ready in one minute at temperature $+50^{o}$ to -30^{o} C and at 1.5 minutes at temperature below -30^{o}C.

During actuation of AGD-1 and normal operation of instrument on ground and in flight, the use of the caging knob is FORBIDDEN!

To test the efficiency of the AGD-1 assembly, the gyrotransmitter housing is moved by means of a pitch and bank device within ranges permitted by its shock absorbers, and the horizon indicator should correspondingly indicate the pitch and bank.

To cage the gyrotransmitter by button, push the "Cage only during horizontal flight" button located on indicator. The caging device should work and the signal lamp should go on. After caging is completed, the lamp should go off. Press button temporarily. Caging should continue until and after release of button.

Switch off AZS [automatic circuit breakers] of "AGD", and of "UFO," portable lamp, KKO-3 heater, signal of AGD. Disconnect "Aircraft Airport Battery" switch.

Disconnect ground power supply.

Testing AGD-1 Master Attitude Indicator [P-251

(While performing routine maintenance)

1. Check indicator error of gyrotransmitter and attitude indicator.

Check out following on gyrotransmitter:

a) Readying time

b) Caging operation

v) Correction speed

g) Rigidity of gyrotransmitter gyroscope with disengaged correction

d) Error in maintaining vertical

zh) Action of longitudinal correction switch

z) Input currents

Check following on horizon indicator:

1) Position of pitch angle correction index and position of aircraft silhouette [fixed miniature aircraft] center point index.

2) Discrepancy between aircraft silhouette and zero graduations on bank dial.

3. Error in indication of pitch and bank angle by artificial horizon.

SECRET

4) Pitch angle correction

5) Signal lamp

6) Input current

Perform the checkout on a special unit prescribed for AGD.

2. Check the accuracy of gyrotransmitter installation. The gyrotransmitter should be fastened so that the needle on housing points toward the nose section of the aircraft, and the fastening point graduation marks that indicate the direction of longitudinal axis of the aircraft match up with the indexes at the bottom of gyrotransmitter. [P-252]

Inaccurate mounting of the gyrotransmitter in relation to the longitudinal axis results in additional error in bank indication reading.

3. Check the accuracy of mounting of horizon indicator AGD-1 surface of indicator face should be parallel with the lateral axis of aircraft, while the ball bank indicator should be in center between graduations when the aircraft is placed in straight line flight position.

Lateral mounting is regulated by laterally reversing the instrument casing relative to the longitudinal axis.

4. Line up "0" on pitch scale with aircraft silhouette and with "0" on bank scale, and aircraft should be in line of flight.

KSI Navigation System

The KSI navigation system serves to ascertain the heading of the aircraft, the landing pattern angles and radio station direction finding.

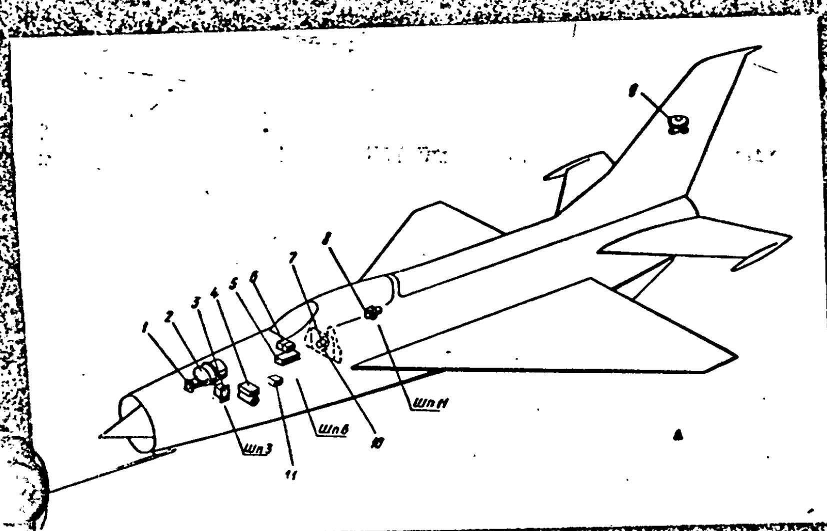
The KSI outfit is composed of the following units (shown in figures 63 and 64):

1. GA-2 gyroscope
2. MS-1 matching mechanism

50X1-HUM

50X1-HUM

Fig. 63 - Course Indicator System Arrangement on Aircraft



Фиг.63 Схема размещения КСИ на самолете

1 – механизм согласования МС-1; 2 – гироагрегат ГА-2; 3 – пульт управления ПУ-3;
4 – преобразователи ПО-500П; 5 – усилитель У-12; 6 – усилитель У-18;
7 – усилитель УГР-4у; 8 – коррекционный механизм; 9 – индукционный датчик ИД;
10 – кнопка согласования КС, 11 – блок реле БР-4.

50X1-HUM

50X1-HUM 50X1-HUM

-274-

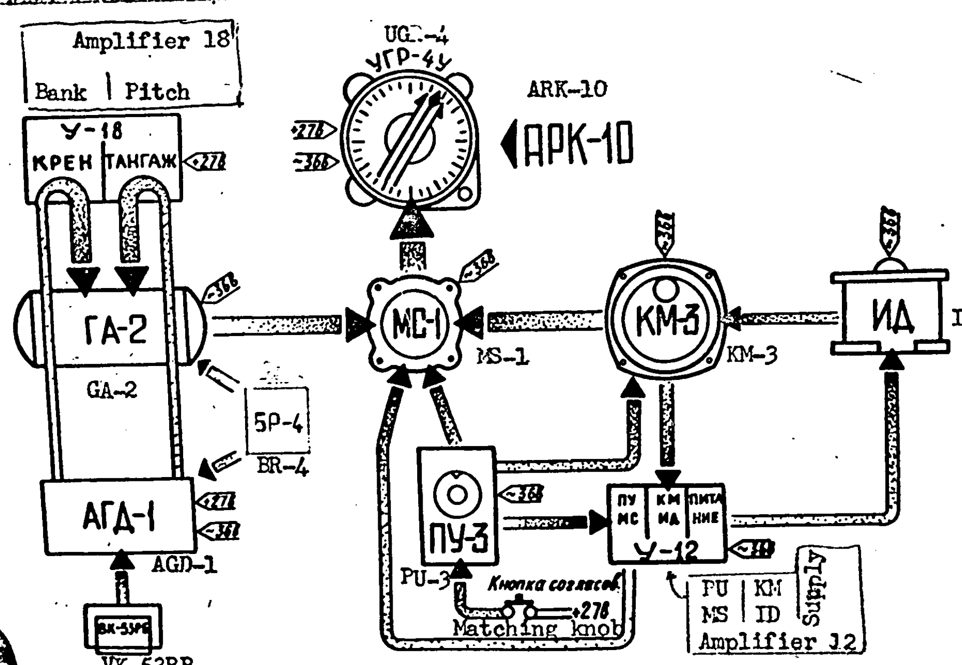


Fig. 64 - KSI System

Фиг. 64. Блок-схема системы КСИ.

Лист №254

3. ID-2 induction transmitter [P-255]

4. KM-3 correction mechanism

5. PU=3 control panel

6. UGR-4U indicator

7. U-12 amplifier

8. U-18 amplifier

9. 5KS matching knob

10. BR-4 relay block

The main layout of the navigation system is shown in figure 65.

Signals from the ARK-10 radio compass provide the information for determining the course angles and the navigational signals from the radio station.

Signals of the AGD-1 gyrotransmitter are used to ensure the operation of the navigation system:

The navigation system is driven by:

a) 27-volt d.c.

b) three-phase 36-volt 400-cps a.c.

Principal Technical Data on the KSI Navigation System

1. Ready to use after power is turned on:

a) Within 1.5 minutes with atmospheric temperature +50° to -30°C.

b) Within 2 minutes with atmospheric temperature of -30° to -60°C.

COMMENT: Ready to use within 3-4 minutes without UZG actuating accelerator

2. Error in determining magnetic course in direct, balanced, horizontal flight is no greater than ±2° [P-257]

3. Error in remote transmission of course angle from automatic radiocompass:

a) No more than $\pm 1^{\circ}$ at zero reading on dial

b) No more than $\pm 2.5^{\circ}$ at other graduations on dial.

The KSI navigational system:

a) ensures the necessary accurate determination of course (not less than $\pm 2^{\circ}$) during horizontal straight flight

b) has no gymbal errors emerging when aircraft is banked

v) ensures high degree of accuracy during non-stop flight

A highly accurate course during a non-stop flight with great degrees of banking is assured by the use of a high-reliability gyroscope in the KSI navigational system and a stabilized axis of the inner gymbal frame of the vertical gyro.

Directional gyro (free gyro) performance is the principal, and magnetic correction performance the secondary, operating condition of the navigation system.

KSI SYSTEM COMPONENTS

[p-258]

1. GA-2 Gyroscope

The GA-2 gyroscope is designed for the operation of the navigation system with the free gyro and for giving direction signals to users (through the matching mechanism).

The gyro is mounted in nose section frame 3.

2. MS-1 Matching Mechanism

The matching mechanism is designed for:

1. Initial matching of direction signals from the GA-2 gyro regarding magnetic course.

2. Correction of direction signals while system operates with the free gyro. The MS-1 mechanism is mounted in the nose section.

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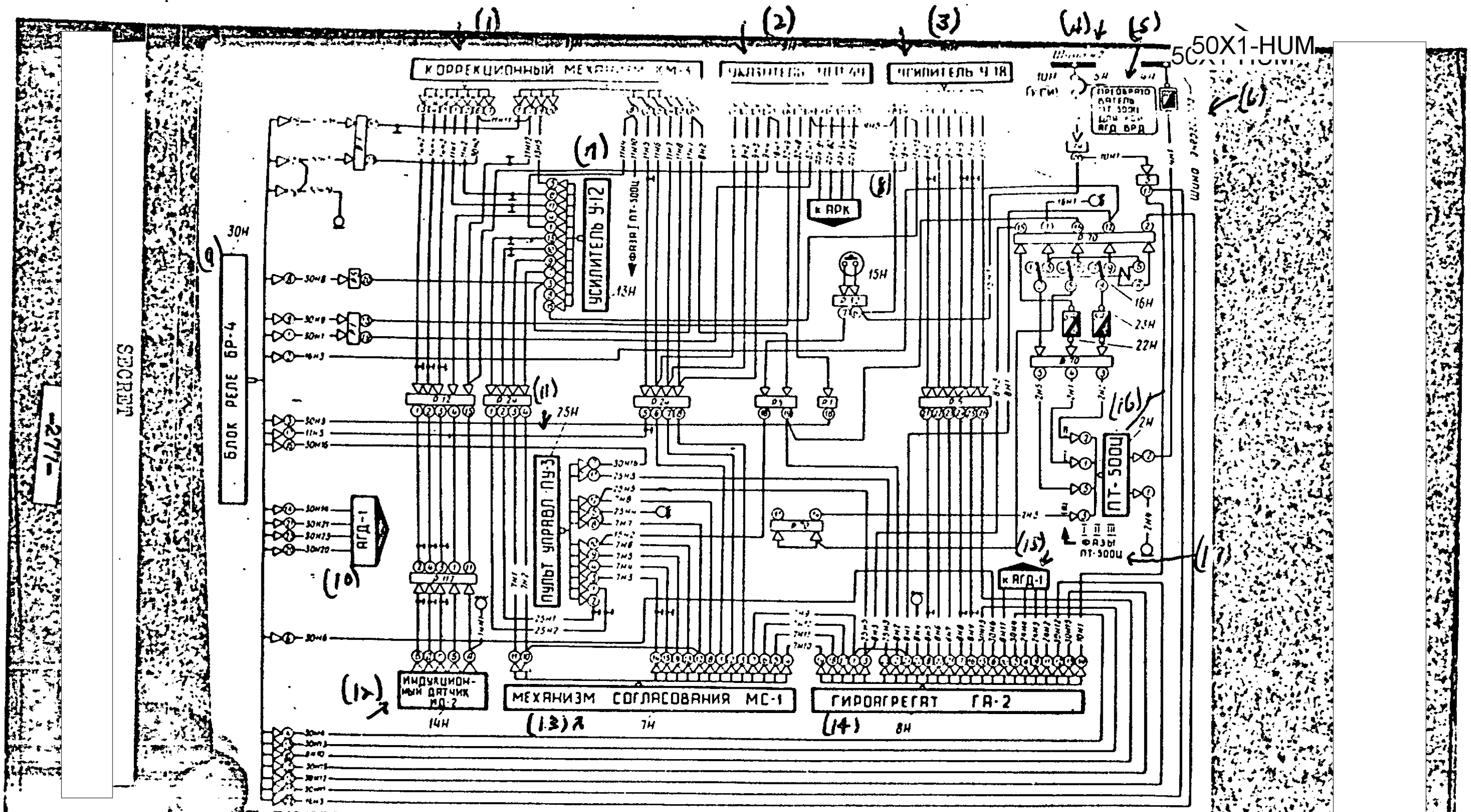
-277-



Фиг. 65. Электросхема питания системы КСИ.

Fig. 65 - Electric Power Supply for KSI System

№ 256

Fig. 65 - KSI System Electric Power Supply [p 277]

(1) Korrektsionnyy Mekhanism KM-3 -- KM-3 Correction Mechanism

(2) Ukazatel' UGR-4U [Indicator of course, magnetic bearing, radio station angles, course deviation]

(3) Usilitel' U-18 -- U-18 Amplifier

(4) Shina -- Busbar

(5) Preobrazovatel' PT 500Ts dlya KSI, AGD, VRD -- PT 500Ts convertor for KSI, AGD, VRD

(6) Shina energouzla -- Power unit bus bar

(7) Usilitel' U-12 -- U-12 Amplifier

(8) k ARK [k avtomaticheskomu radiokompasu - to automatic radio compass]

(9) Blok rele BR-4 -- BR-4 Relay Block

(10) AGD-1 -- Remote Attitude Indicator

(11) Pul't upravleniya PU-3 -- PU-3 Control Panel

(12) Induktsionyy datchik ID-2 -- ID-2 Induction Transducer

(13) Mekhanism soglasovaniya MS-1 -- MS-1 Matching Mechanism

(14) Gidroagregat GA-2 -- GA-2 Gyro

(15) k AGD [k Aviagorizont distantsionnyy -- to remote attitude indicator]

(16) PT-500Ts [Convertor]

(17) Fazy PT-500Ts -- PT-500Ts phases

3. ID-2 Induction Transmitter

The ID-2 induction transmitter serves to correct the magnetic course signals picked up from the gyro through the matching mechanism. The ID-2 transmitter is installed in the tail fin.

4. KM-3 Correction Mechanism

The correction mechanism is designed:

1. To mechanically process the electric signals of the ID-2 induction transmitter, and
2. To eliminate quadrantal deviation and instrument inaccuracies of the navigational system.

The correction mechanism is mounted in the compartment on the right side, between cross members Nos 10 and 11. [P-259]

5. PU-3 Control Panel

The PU-3 control panel is designed:

1. To ensure navigational system operation
   a. In the northern and southern hemispheres
   b. With the use of magnetic correction and the free gyro
2. To introduce latitude correction and adjustment of deviation of gyroscope in azimuth to avoid unbalance.
3. To regulate speed of latitude correction and magnitude of feedback.

The control panel is mounted in cross member No 3 on the right side in the upper front equipment compartment.

6. UGR-4U Indicator

The UGR-4U indicator serves to indicate the heading of the aircraft, the magnetic bearing and course angles of the radio station, and also to emit signals of deviation from the desired course.

The UGR-4U indicator is mounted on the instrument panel.

7. U-12 Amplifier

The U-12 amplifier is composed of two amplifying channels, KM and MS. The KM channel amplifies the alternating current signal coming from the induction transmitter.

The MS channel:

1. Amplifies the 400 cps alternating current signal coming from the correction mechanism and feeds it into the MS-1 matching mechanism.

2. Amplifies the signal coming from the PU-3 control panel and feeds it into the matching mechanism. P-260

The U-12 amplifier is mounted in cross member No 6 in the compartment.

8. U-18 Amplifier

The U-18 amplifier amplifies the pitch and bank signals coming from the pitch and bank potentiometers of the GA-2 gyro assembly.

The U-18 amplifier is mounted in cross member No 6 in the compartment.

9. 5-K Directional Gyro Knob

The 5-K directional gyro knob is designed for initial matching of course signals from the gyro assembly (through the coordinating mechanism) with the position of the induction transmitter relative to the magnetic meridian.

The 5-K directional gyro knob is mounted on the instrument panel.

10. Switching on the Navigational System and Checking the Performance of the KSI System on the Aircraft

1. Switch on the KSI navigation system for 1.5 minutes before use (with atmospheric temperature of 50^{o} to -30^{o}C), for at least 2 minutes (at -30^{o} to -60^{o}C), and for 3-4 minutes when performing without UZG actuation accelerator.

Switch on the power for the KSI system according to following procedure:

a) Connect 27-voltage D.C. on the ground into the aircraft circuit

b) Switch on the "aircraft or airport storage battery switch" which is located on right panel.

v) Connect the AZS switch [automatic circuit breaker] of the "AGD" on right panel /

g) Connect the AZS switch on right panel "UFO, portable lamp, KKO-3 heater, signal AGD."

Afterwards, when the signal lamp on the AGD-1 directional indicator goes out, connect the AZS switch of the "KSI."

Within 1.5-2.0 minutes after the AZS switch of "KSI" is connected, the navigational system is ready to be tested.

When disconnecting the power supply for the navigational system, the following procedure must be observed:

a) Disconnect AZS of "KSI"

b) Disconnect AZS of "AGD"

v) Disconnect AZS "UFO, portable lamp, heater KKO-3, signal AGD"

g) Switch off "on-aircraft or airport storage battery switch" and disconnect ground power supply.

Ground power supply for the directional system is not to be switched on again for at least 4 minutes after disconnection.

ATTENTION: Procedure for connecting, disconnecting and connecting ground power supply for directional system is to be strictly observed.

2. Check out accuracy of joint performance of gyro assembly GA-2 and gyrotransmitter. Perform check according to following procedure: [P-262]

a) Connect power supply for KSI system, as indicated above.

b) Rotate the gyrotransmitter with a device or manually around longitudinal axis to imitate right and left banking. When right banking is imitated, the light spot observed through sight hole of the GA-2 assembly (from side of stem of pointer "aircraft heading" on GA-2 casing), should move to the left. When the left banking is initated, the light spot should move to the right. (Rotate gyrotransmitter within limits allowed by shock absorbers)

v) Rotate gyrotransmitter around lateral axis and imitate pitch and dive. Lighted spot should move upwards when pitch is imitated, and downwards when dive is imitated. (Rotate gyrotransmitter within limits allowed by shock absorbers).

3. Check latitude correction of course system operating with the directional gyro as follows:

a. Set PU-3 latitude potentiometer dial on "56". The reading on the correction potentiometer scale, which is located under the latitude potentiometer handle cover, should correspond to the indication entered under "V" in Table No 1 of the composite certification for the "KSI" assembly.

b. Set latitude potentiometer dial of PU-3 control panel on "90" and latitude correction on-off switch in "North" position. The aluminum indicator disc (with red field) seen through sight hole of MS-1 matching mechanism should turn clockwise (when observed from side of MS-1 dial). [P-263]

SECRET

Set on-off switch on PU-3 panel in "South" position, and indicator disc should rotate counterclockwise.

v. Set on-off switch on PU-3 panel in "North" position, reverse dial of latitude potentiometer on PU-3 panel to "Zero" reading, and watch for turning of indicator disc to slow down. (Disc may be stopped). After a gradual stop, the disc may alter its direction of rotation.

g. Check gyroscope deviation in the assembly by setting potentiometer latitude dial on graduation mark corresponding to latitude of given location; placing on-off switch in "North" position; fixing magnetic course reading, and by connecting the stop watch.

The change in magnetic course reading (i.e., gyroscope deviation) should not exceed $\pm 1^{\circ}$ during test of 15 minute performance. If deviation exceeds $\pm 1^{\circ}$ during the 15-minute test, the test continues for 30 minutes, in which case the permissible deviation is $\pm 2^{\circ}$.

Comment: 1.Do not check gyroscope deviation sooner than 5 minutes after power supply is turned on. [P-264]

2.While gyroscope deviation check is under way, do not move or nor perform assembly work on aircraft that could cause GA-2 gyro assembly or aircraft to sway on course.

4. Check matching speed of course system by pressing on matching knob until pointer stops or oscillates near matching position within range of $\pm 5^{\circ}$

The course indicator reading should correspond approximately to magnetic course of aircraft.

Compare course indicator dial readings with correction mechanism readings, which should differ from each other by $3^{\circ} + 5^{\circ}$.

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Then, with the matching knob pushed in, place a permanent magnet near the ID-2 induction transmitter in such a way that readings on course indicator increase course by 160-170°, and then quickly remove magnet at least two meters away from induction transmitter.

When permanent magnet is being removed from induction transmitter, connect stop watch (keep matching knob pressed in all the while). The pointer should shift to previous course with a maximum error of ±1°. [p-265]

Disconnect stop watch the moment the pointer occupies the former matching position or begins to oscillate near such position within maximum range of ±0.5°.

To determine the matching rate, the angle of pointer rotation must be divided by the time measured with the stop watch. The obtained matching rate should not be less than 8° per second.

Repeat the indicated check in favor of shortening the course.

After all tests have been performed, disconnect the course system power supply by observing procedure indicated above.

Pre-flight Test

1. Check the operating efficiency of KSI system by switching on the AZS "AGD" and AZS "UFO", portable lamp, KKO-3 heater, signal AGD.

After signal lamp on AGD indicator is turned on, connect AZS "KSI". Within 1.0-1.5 minutes after power supply is turned on, press the matching knob and keep it pressed until course indicator pointer stops completely; then take magnetic course reading to be convinced of accuracy of reading on course indicator.

[p-266]

COMMENT: Dial readings should correspond with magnetic course of aircraft parking location with no bulk steel near air craft distorting magnetic field of earth.

If necessary, set the desired course with the rack-and-pinion of the dial.

2. Set reverse switch on PU-3 control panel into "North" position during flights to northern hemisphere.

3. Set latitude dial on PU-3 control panel at latitude of departure point; during flights within radius of 450-550 km, the setting on the latitude dial need not be changed.

During longer flights (with latitude changing more than 4-5°), set the latitude dial on the control panel at the mark corresponding to the mid-latitude of the flight.

Disconnect the power supply according to the procedure mentioned above.

EUP-53 Electric Turn Indicator

The EUP-53 electric turn indicator is designed to indicate the proper performance of turns by aircraft when flying at lateral pitch up to 45° at speeds up to 500 km/hr. (Fig. 66 and 67)

During operation, wathc that the liquid in the tube of the bank and turn indicator is clear and contains no air bubbles when the instrument is in working order.

The pointer of the turn indicator should not differ from the zero reference mark by more than $\pm 1°$. [P-268]

Within every 50 hours of flight, check the efficiency and accuracy of the turn indicator on a special UPG-48 unit according to the reference marks shown on the instrument plate.

AM-10 Accelerometer

The AM-10 accelerometer [g-meter] is designed to determine the forces affecting the aircraft in the direction perpendicular to the plane of the wing.

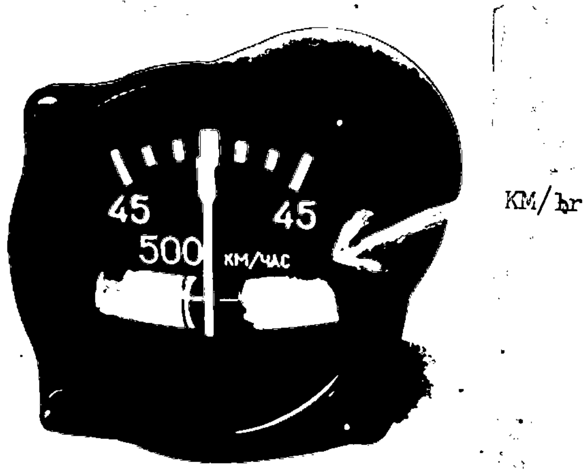

Fig. 66

Фиг. 66.
Указатель поворота ЭУП-53

Turn Indicator EUP-53

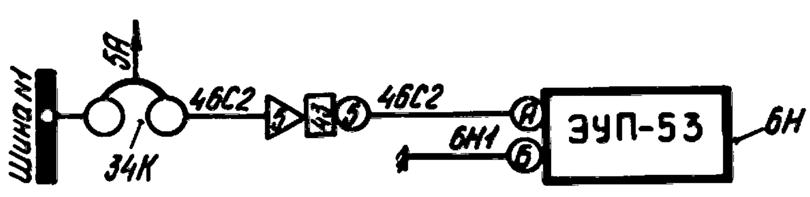

Fig. 67. EUP-53 Electrical Arrangement

Фиг. 67.
Электросхема питания ЭУП-53

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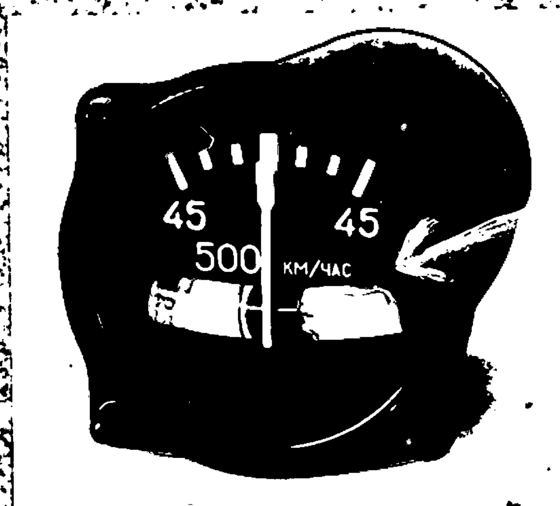

KM/hr

Fig. 66

Фиг. 66.
Указатель поворота ЭУП-53

Turn Indicator EUP-53

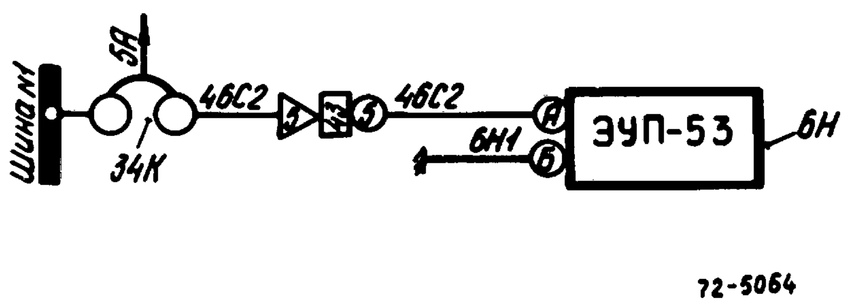

Fig. 67. EUP-53 Electrical Arrangement

Фиг. 67.
Электросхема питания ЭУП-53

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Properly mounted instrument should indicate, when the aircraft is in horizontal position on the ground, acceleration of 1g, correction $\pm$ 0.2g.

To prevent maladjustment of the mechanism, avoid sharp impacts and vibrations.

The pointers on the AM-10 g-meter should be in the starting position when knob is pressed.

Watch for correct position of pointers. Before flight, set pointers on the accelerometer at the one position.

Chapter III

ENGINE OPERATION CONTROL INSTRUMENTS

[p 269]

ITE-2 Remote Electrical Tachometer

The ITE-2 remote electrical tachometer (fig. 68) is designed for the continuous remote tele-metering of the r.p.m's of the compressor shafts of the engine in terms of the percentage of the maximum r.p.m.

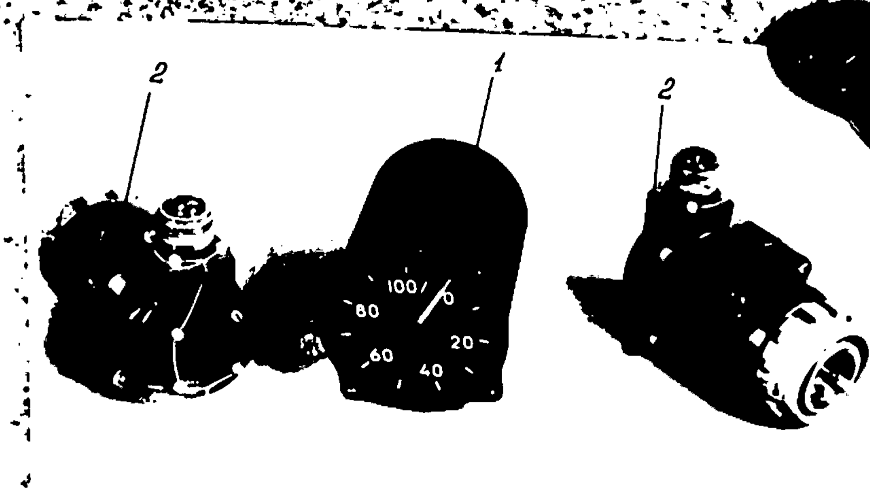
The measuring scale is calibrated from zero percent to 105 percent and is numbered from zero percent to 100 percent. The scale is uniformly calibrated by one-percent reference marks.

The ITE-2 assembly consists of one ITE-2 dial and two DTE-1 transducers, which are mounted on the engine (figs 68 and 69).

The double-dial (two-pinter) ITE-2 instrument indicates, within the range of zero percent to 105 percent, the r.p.m. of each rotor, RND (Low Pressure Rotor) and RVD (High Pressure Rotor).

Whenever the outfit is replaced, the new set should be checked for error at normal temperature. The tachometer and its transducers should be checked for error as a set with a special tachometer unit. When the tachometer is used, the accuracy of indications should be checked after every 100 hours of operation, and the inter-phase voltage of the transducers should be measured when the r.p.m. reading on the indicator scale is 60 perdent.

Fig. 68 The ITE-2 tachometer unit
1. The ITE-2 indicator
2. The DTE-1 transmitters (2 items)



Fig, 68 ITE-2 Tachometer
1. ITE-2 Indicator
2. DTE-1 Transducers (2 units)

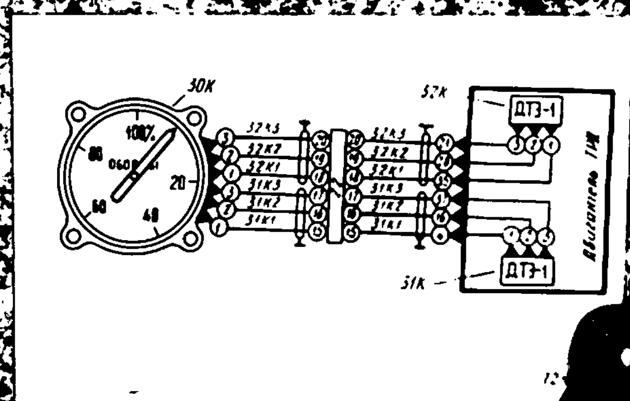


Fig. 69 Electric Wiring for ITE-2 Units

Fig. 69 The electrical circuit diagram

A check should be made if the wires connecting the transducers and the indicator are properly joined together.

TVG-11T Gas Thermometer

The TVG-11T gas thermometer (figs. 70 and 71) is designed to gauge the average temperature, between 300° C and 750° C, of gases discharged back of the engine turbine. The TVG-11T thermometer set consists of:

The TVG-1 indicator that is mounted on the instrument board; a transducer consisting of four T-1 thermocouples; and four spare thermocouples.

Four thermocouples are installed in specially-provided union adapters on an extended pipe.

The connecting terminal block (one unit) is installed on Frame No 31 in the tail end of the fuselage.

When the TVG-11T set is replaced, the indicator indication error should be checked on a special unit. The gauge and thermocouples are interchangeable only with units of the same calibration group. The connecting wire system is replaceable as a set. A check on the accuracy of the indications should be performed after every 100 hours of operation, and the thermocouple cut-out and opening should be cleaned periodically.

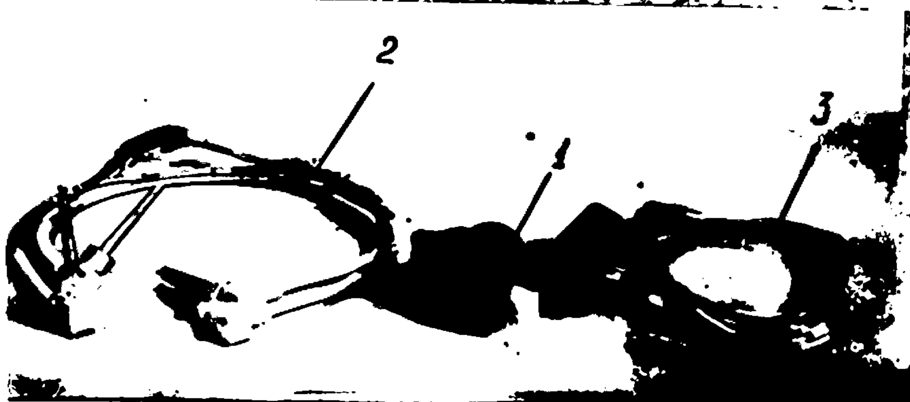


Fig. 70. TVG-11T Assembly

1. Indicator dial
2. T-1 Thermocouples
3. Connecting Cable

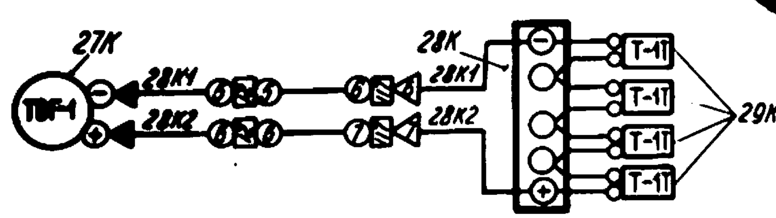


Fig. 71. Electric wiring for TVG-11T 11T.

фиг. 71.

RTS-16A-4 Cumulative Fuel Consumption Meter

The RTS-16A-4 cumulative fuel consumption meter (figs. 72 and 73) is intended to measure the quantity of fuel which is consumed by the engine.

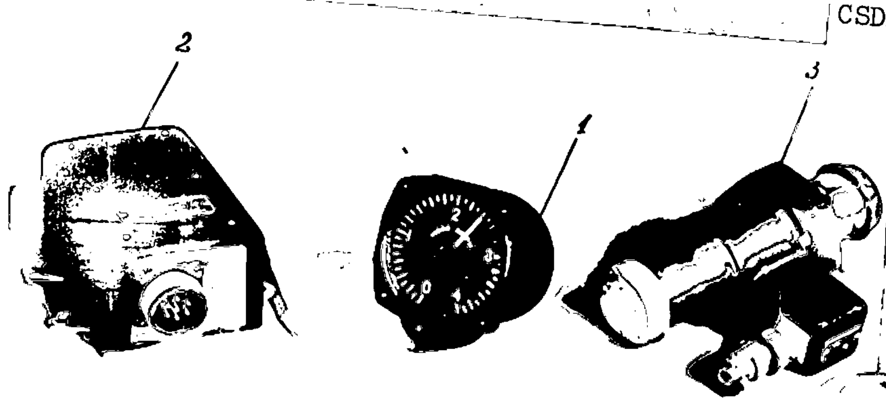
The indicating instrument of the consumption meter indicates the quantity of fuel that remains in the aircraft tanks with efficient fuel lines.

The indicating instrument scale is calibrated from zero to 4,000 liters, with each figure on the scale denoting 1,000 liters.

The consumption meter assembly consists of a transducer, an indicating instrument, and a thyratonic circuit breaker. The transducer is mounted between cross frames Nos 20 and 22, whereas the thyratonic circuit breaker is mounted on frame No 13 on the right side.

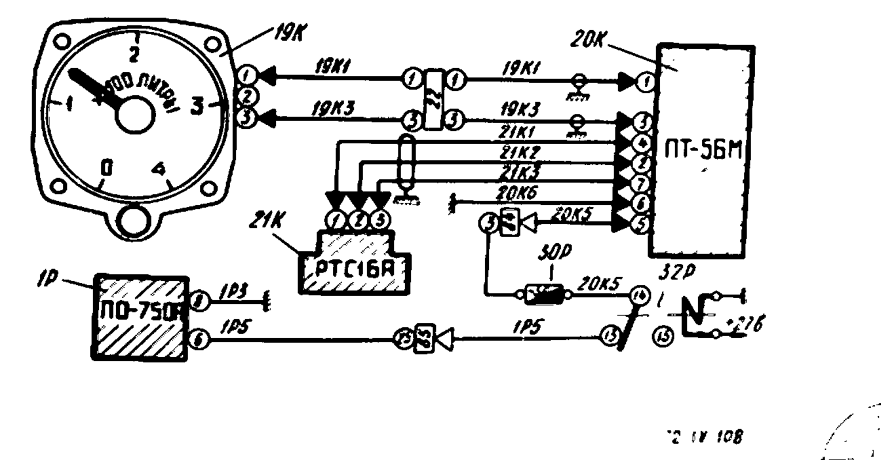
When the RTS-16A-4 consumption meter is used, it should be checked for indication error after each 100 hours of operation. In addition, the fuel lines should be checked so that they are open and do not leak. The fuel flowing into the transducer must be clean in order to prevent clogging of the transducer.

If the meter operates inefficiently, it should be removed after blocking the pipe line.



Фиг. 72. Комплекс РТС-16А-4
1. Указатель.
2. Тиратронный прерыватель ПТ-56М.
3. Датчик расходомера РТС16А.

Fig. 72. RTS-16A-4 Assembly
1. Indicator
2. Thyrotronic circuit breaker
3. Transducer



Фиг. 73. Электросхема комплекта

Fig. 73. Electric wiring for RTS-16A-4

DIM-8T Remote Induction Manometer

The DIM-8T remote induction manometer (figs. 74 and 75) is intended to measure the oil pressure of the aircraft engine within a range of zero to 8 kg/cm^2.

The DIM-8T outfit consists of an induction pressure transducer and of an electric indicator. The indicator is mounted on the instrument board, and the transducer on the engine.

The DIM-8T outfit operates on a.c. of 36 volts, 400 cps. If the transducer is replaced, the airtightness of the system and the proper operation of the outfit must be checked.

When there is no pressure while the current is on, the indicator pointer should rest on the zero mark of the scale. When the current is turned off, the pointer drops below the zero mark.

The oil pressure should be checked when the engine is tested during preflight preparations. When the DIM-8T outfit is used, the transducer and the indicator should be taken off and checked for indicator error after every 50 hours.

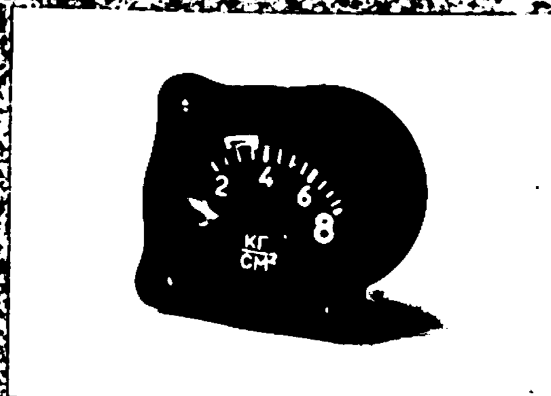
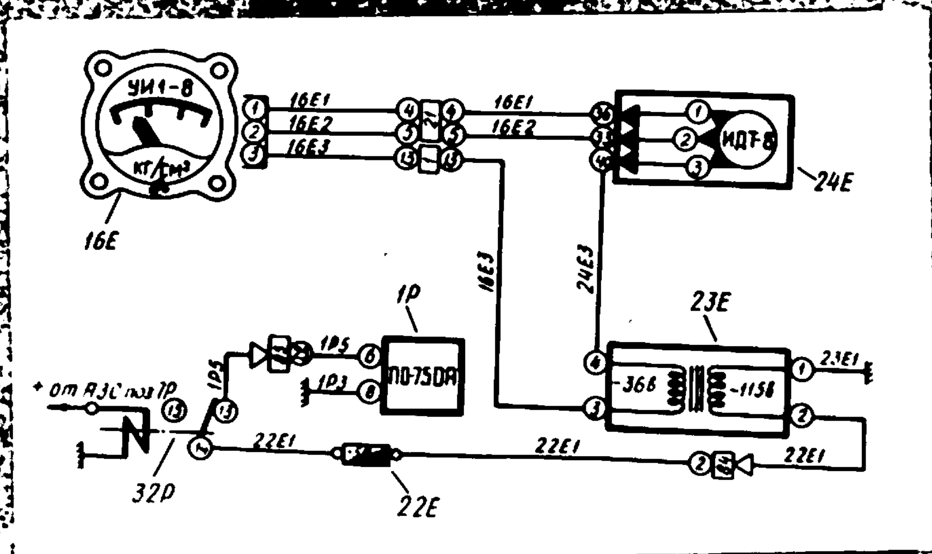


Fig. 74. DIM-8T Indicator



Электросхема комплекта ДИМ-8Т

Fig. 75
Electric wiring for DIM-8T

CHAPTER IV.

[p 277]

INSTRUMENTS CONTROLLING THE OPERATION OF INDIVIDUAL UNITS AND SYSTEMS

The SD-3 Pressure Signal Unit

The SD-3 fuel pressure signal is intended to warn of a drop in fuel pressure in the main fuel lines.

The pressure signal turns on a warning lamp when the excess pressure in the fuel line becomes less than 0.3 kg/cm^2.

Three SD-3 components are installed for controlling the operations of the pumps of tank groups Nos. 1, 2 and 3.

The warning unit for tank group I is mounted at the lower left between frames Nos 15-16. The warning unit for supply tank group II is located between frames Nos 16 and 16/A at the left bottom section. The unit for tank group III is installed between frames Nos 17 and 19 on the left side.

The SDU-2-0.35 pressure indicator for controlling the work of the overhead fuel tank is mounted between frame Nos 26 and 27.

The SD-3 pressure signal unit should be checked for operational error and for airtightness of the instrument housing. The error from use should not exceed $\pm$0.05 kg/cm^2.

The instrument housing should be checked for airtightness by the dynamic build up of pressure equivalent to 300 mm Hg in the static and dynamic pressure systems. [p 278]

The pressure should not decline more than 8 mm Hg during a period of one minute.

2EDM-250 Electric Remote Pressure Gauge

[p 278]

The 2EDM-250 electric remote pressure gauge (figs. 76 and 77) is designed to measure the oil pressure in both the main and booster hydraulic systems of the aircraft. The 2EDM-250 electric remote pressure gauge consists of two electrical pressure-sensing transducers and an electrical indicator. The transducers are mounted between cross member frames Nos 22 and 23.

When the 2EDM-250 outfit is used, it must be checked after every 100 hours to determine indicator error and if the unit is airtight. When the current is on and there is no pressure in the hydraulic system, the indicator pointer should rest at the zero mark on the scale.

In the event of incorrect indication, it is necessary to locate the defect. To do this, the transducer and indicator must be replaced in turn with same types of units known to be in good condition. If the transducer or indicator of a particular set gets out of order, it should be replaced with a corresponding component from another set of the same type. Following replacement, the indications should be checked out with a master gauge and the corrections should be entered on the set's rating plate.

AChKho Aircraft Clock

[p 280]

The AChKho aircraft clock (fig 78) serves to determine the exact time while in flight. During operation of the aircraft, the clock should be wound once every 5 days for normal operations.

When the temperature is below minus 25° C, accurate operation is assured by switching on an electrical heater (fig 79).

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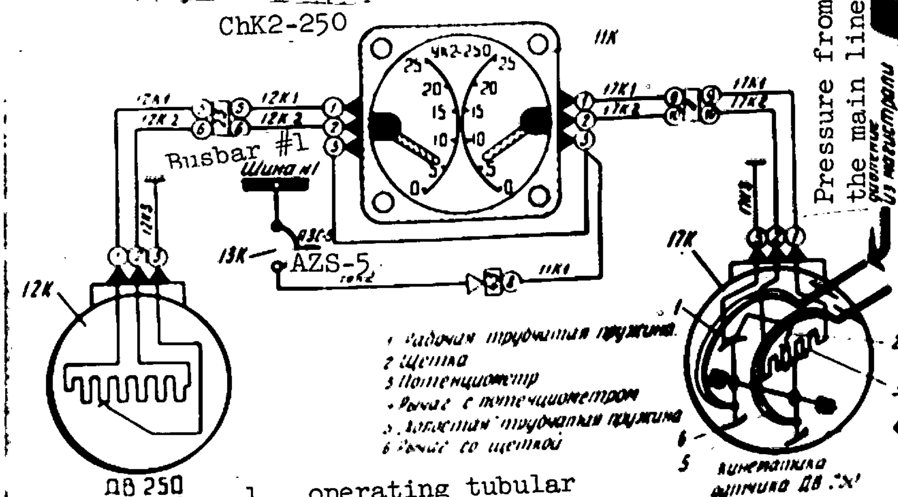
Фиг.76 Комплект 2ЭДМ-250
1. Указатель УК2-250
2. Датчик ДВ-250 -/2шт./

Fig. 76. 2EDM-250 Set
1. UK-2-250 indicator
2. DV-250 transducer -/twounits/.



kinetics of DV 250 transducer.

1. operating tubular spring
2. Brush. 3. potentiometer. 4. lever with potentiometer. 5. stationary tubular spring
6. lever with brushes.

Fig. 77. Electrical circuit diagram of 2EDM-250 set.
Фиг. 77. Электросхема комплекта 2ЭДМ-250

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UVPD-20 Pressure "Altitude" and Drop Indicator

The UVPD-20 pressure "altitude" and drop indicator (fig. 80), with cabin pressure "altitude" indication within range of 0-20 km and pressure drop indication within range of -0.04 to +0.6 kg/cm^2 is designed for simultaneous measurement of "altitude" and drop in pressure (relative to atmosphere) in pressurized cabin.

During operation, the UVPD-20 instrument should be inspected:

1. To determine if pressure gauge housing is airtight, and
2. To determine reading error at normal temperature.

The pressure gauge housing is checked for airtightness by means of the pressure drop indicator pointer. To do this, pipe connection "S" should be connected with a vacuum pump and when a vacuum corresponding [p 282] to 0.6 kg/cm^2 is attained, the vacuum should be cut off, the hose on pipe connection "S" should be squeezed, and changes in instrument reading should be looked for during a period of one minute.

There should be no change in the instrument reading during the course of one minute.

Instrument reading errors are found in this manner:

a. Connect pipe unions "S" and "D" of the UVPD-20 instrument with a vacuum source, and create in the system a vacuum equivalent to altitudes of 3, 6, 9, 12, 15, 18 and 20 kilometers.

The extent of error of each checked scale mark can be determined by finding the difference between each reading mark of the tested instrument and the real value of the measured quantity that is determined ~~in~~ with a mercury pressure gauge.

Fig. 78. AChKh clock

Фиг. 78
Часы АЧХ

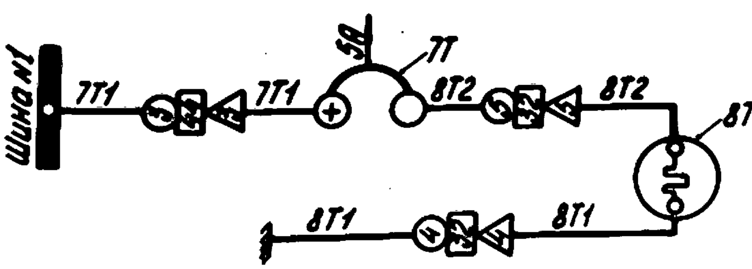

Fig. 79. Electrical Circuit of the AChKh clock

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Фиг. 79

b. To check the pressure drop indicator, pipe union "S" should be first connected with a vacuum pump and a vacuum of zero, 0.2, 0.4, and 0.6 kg/cm^2 should be developed in the systems.

Pipe union "S" should then be connected with the source of pressure, and pressures of 0.002 and 0.004 kg/cm^2 should be developed within the system.

The extent of indicator error on each checked scale marking should be determined by finding the difference between the reading on the particular mark and the real value of the measured quantity, which is determined on a mercury pressure gauge.

In determining the error of the instrument reading, the following conditions should be observed:

a. The check should be performed at a normal temperature of +22°C, ±5°C.

b. Testing vibration range with load from [redacted] vibration, 0. 1 g to 0. 3 g.

v. The position of the instrument should conform to its position when in operation.

ARU-3V [Stabilizer] Lever Arm Position Indicator [p 284]

The ARU-3V type unit serves for the automatic change, according to a special non-linear low, of the transmission ratios from the control stick to both the stabilizer and to the spring loading mechanism.

The electrical mechanisms are controlled by two switches which are located on the left panel "High Speed and "low speed", "Automatic" and "Manual", and "ARU".

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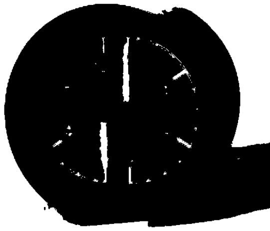
Pressure Drop

Fig. 80

UVPD-20 Cockpit Altitude and Pressure Gauge

Fig. 81. Indicator of the Air



Air

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MV-12 Air Pressure Gauge

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During manual operation, the second switch should be in the "Manual" position.

The operation of the actuating mechanism is checked by a signal lamp in Table T-4 of the takeoff-landing unit "Stabilization for Landing" (large leverage arm), and by an indicator with a scale that is marked off in kilometers per hour, and in kilometers of flight altitude really done by the actuating rod of the mechanism.

The [stabilizer] arm indicator is an ordinary voltmeter, which is calibrated in both speed units and altitude units.

Under operating conditions, the readings on the [stabilizer] lever arm position indicator and on the pilot's speed and altitude instruments may somewhat vary because of deviations of atmospheric conditions from standard values and also because of variations in the supply voltage. [p 285]

It should be kept in mind, that the [stabilizer] lever arm position indicator -- an indicator of the operation of the automatic system serves for the over-all orientation of the pilot regarding the unfailing operation the ARU automatic system. During operation, the AZU-3v should be checked under laboratory conditions every 50 hours for all its operating parameters.

The 2M-150 Air Pressure Gauge

The 2M-150 dual air pressure gauge (fig 81) serves to indicate the air pressure in the main and emergency systems of the aircraft. The scale range is from zero to 150 kg/cm^2 with each point denoting kg/cm^2.

During the operation of the 2M-150 pressure gauge, it is necessary to check the airtightness of the dynamic system, and instrument indication error.

In order to check the airtightness of the dynamic system, both of the instrument connecting pipes should be connected with a pressure source and a pressure of 225 kg/cm^2 should be developed on a master pressure gauge. When this pressure has been attained, the pressure source should be turned off with a valve, the pointer of the master pressure gauge should be observed for five minutes, and then the pressure should be [p 286] reduced to one maintained at 150 kg/cm^2 while the readings of the master pressure gauge are observed. There should be no drop in pressure.

MV-12 Pressure Gauge

The MV-12 air pressure gauge indicates the air pressure in the brake system of the main wheels of the chassis when the brake lever is applied on the control stick of the aircraft.

The instrument has two dials that are calibrated from zero to 12 kg/cm^2, with each mark indicating one kg/cm^2.

When used, the instrument should be checked every 100 hours of flight for airtightness of the housing and for indicator error.

The K-717 Barospeedograph

The K2-717 barospeedograph is mounted near cross frame members Nos. 11 and 12. In all cases, when the barospeedograph is removed from the aircraft, the rubber canvas hoses should be plugged with stoppers. During pre-flight preparations, it is necessary to check if there are stoppers in the rubber canvas hoses by removing the hatch cover, which is located between frame cross members Nos 11 and 13 in the lower part of the fuselage.

When the K2-717 barospeedograph is mounted on the aircraft, the stoppers should be removed and the rubber canvas hoses and the pipe joint should be connected to the barospeedograph.

AFA-39 Aerial Camera [p 287]

The AFA-39 aerial camera, which is operated by a remote control device, is designed to equip jet fighters to fulfill assignments of daytime aerial photo reconnaissance.

The aerial camera is designed for use at altitudes of 500-5,000 meters and flight speeds up to 1,500 km/hr.

The AFA-39 can also take photographs from altitudes of 17,500 meters at true flight speeds of 1,600-1,900 km hr. The aerial camera is installed in the right removable section of the wing, between ribs Nos. 1 and 2. The aerial camera is operated from the cockpit, in which switch AFA-39 and the remote control device are installed (fig 82).

The aerial photographic equipment consists of:

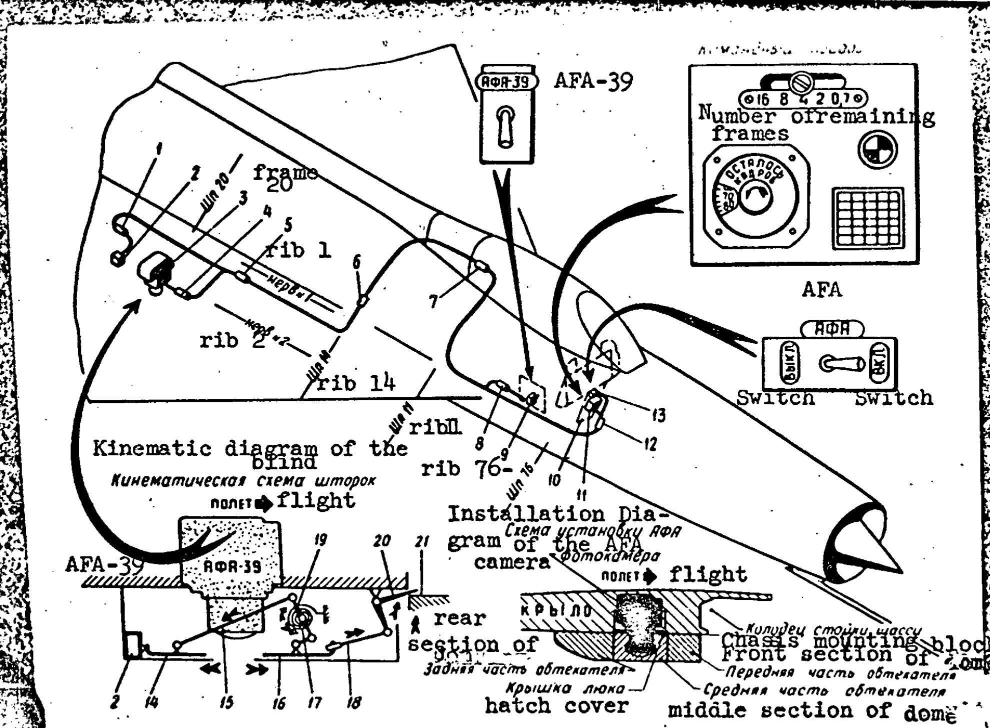
1. Aerial camera
2. Remote control device
3. Switch
4. The over-all diagram of the AFA-39 is shown in Figure 83.

Operational Instructions for the AFA-39. Preflight Instructions

1. If the film in the aerial camera has not been completely exposed and is to be used in a forthcoming flight, the instructions in paragraphs 2 and 3 of this section must be carried out.

. See whether the required exposure setting on the camera corresponds with the desirable exposure setting.

FIGURE 82. Diagram showing location of the AFA-39 [and its various components] on the aircraft



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Фиг. 82. Схема размещения АФА-39 на самолете.

Figure 82. Diagram Showing Location of the AFA-39 [and its various components] on the Aircraft

[p 289]

1. R-165 (ShR-2) Connector
2. The terminal disconnecting switch of the KV-9A interlocking device
3. The AFA-39 aerial camera
4. The ShR32PK8EShZ connector
5. The R-154 (ShR-7) connector
6. The R-96 (Sh-7) connector
7. The air-tight connector R-14 (ShRG-7)
8. The R-74 (ShR-23) connector
9. The AZS automatic circuit breaker
10. The middle panel (instrument board)
11. The remote control devide
12. The ShR32PK8EGE connector
13. The disconnecting switch of the camera
14. The rear blind
15. The traction
16. The front blind
17. The return spring
18. The lead traction
19. The two-arm straight lever
20. The two-arm angular lever
21. The brace on the flap of the landing gear strut

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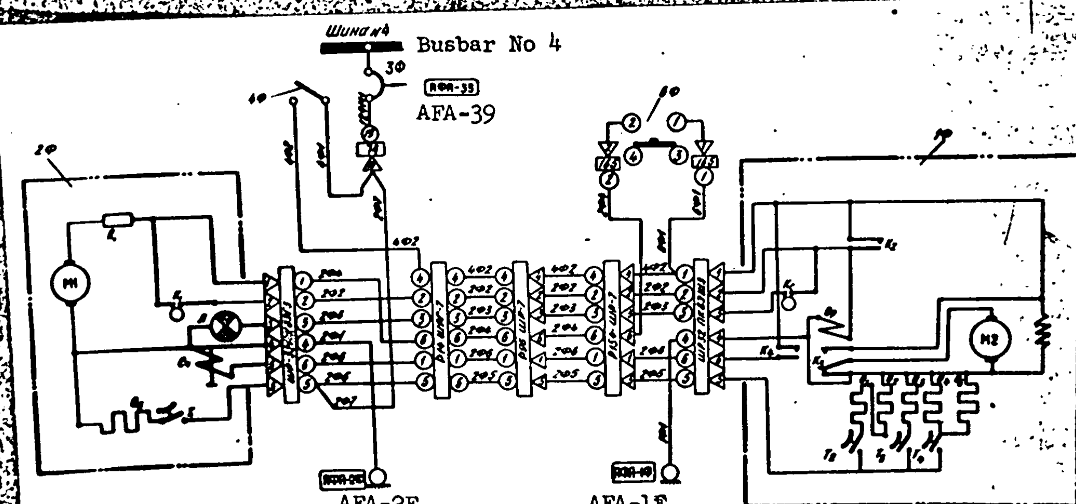

Figure 83. The overall electrical circuit diagram of the AFA-39 aerial camera.

Фиг. 83. Принципиальная электросхема [redacted] аэрофотоаппарата АФА-39.

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Fig. 83 The AFA-39 Power Supply Wiring Diagram

1F - The AFA-39 aerial camera

2F - The remote control device

3F - The AZS-10 automatic circuit breaker

4F - The 87K disconnecting switch

6F - The KV-9A terminal disconnecting switch

2. If the filter or the aperture on the camera must be changed, but the shutter speed is to remain the same, it is necessary: [p 292]

a. To remove the center part of the fairing from the hatch cover by removing four screws;

b. Insert the proper filter and adjust the diaphragm to the proper aperture;

v. Replace the central part of the fairing to its original position with screws;

g. Test the performance of the aerial camera by carrying out instructions described in paragraphs 5, 6, and 7 of the preliminary preparations section.

3. If the exposure time has to be changed, then the following procedures must be carried out:

a. Unfasten the aerial camera along with the hatch cover and the central part of the fairing as explained in paragraph No 2 of the preliminary preparations instructions, and without disconnecting the electric plug, lower the camera a little and adjust the shutter to the desired speed. The new shutter speed must be recorded.

b. Place and fasten the aerial camera together with the hatch cover and the central fairing section in their original position;

v. Test the aerial camera performance, following the instructions in paragraphs 5, 6, and 7 of the preliminary preparations section.

4. If the aerial camera has not been loaded with film before the flight, then all instructions mentioned in sections "Post-flight handling of AFA-39" and "Preliminary Preparations", must be carried out with the exception of item 1 in both sections.

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Post-Flight Handling of the AFA-39 [p 293]

1. Test the AFA-39 in the presence of the pilot according to the instructions in paragraphs 6 and 7 of the preliminary preparations. In cases where all the film has been used up, check aurally according to paragraph 6, and record all the pilot's remarks about the performance of the aerial camera.

2. Remove the aerial camera together with the hatch cover and the central section of the fairing. To do this it will be necessary:

a. to remove the attachment bolts, and to unfasten a portion of the wing fairing, where the central part of the aerial camera fairing is located;

b. to unscrew, through the landing gear strut well, the aerial camera plug socket receptacle and to disconnect it;

v. to remove the phillips screws which hold the camera hatch cover in place, and to remove the aerial camera together with the hatch cover and the central part of the fairing. While removing the aerial camera and supporting the whole unit, it is necessary that the pull rod in the forepart of the fairing is disconnected from the front curtain of the central section of the fairing by pressing down on the angular lever arm in the nose section of the fairing and then exerting an upward pressure so the pull-rod moves into the front part of the fairing and does not interfere with the removal of the unit.

3. Turn over the camera mechanism with the hand crank until the shutter is closed to prevent crippling of the spring. Cover the lens with a lens cap.

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4. Place the aerial camera into a changing-bag which is a regular part of the AFA-39 airborne equipment, or move it in a camera-case into a darkroom, and reload it according to the AFA-39 technical instructions. The inspection of parts and the elimination of defects from the aerial camera must also be carried out in accordance with the instructions. [p 294]

Preliminary Preparations

1. Inspect all the units, parts, and electric cables of the aerial camera assembly and see whether they are fastened properly. If the pilot comments that something is out of order, eliminate the causes of malfunction.

2. After the camera has been loaded with film, remove the lens cap and insert the proper light filter. Set the proper shutter-speed and lens opening, and record the exposure.

3. Whenever the camera is loaded with a new aerial film, the counter scale of the remote control device in the cockpit should be set at "200".

4. The aerial camera, together with the hatch cover and the central part of the wing fairing is then mounted back on the plane, in reverse procedure indicated in paragraph 2 of the section "Post flight work with AFA-39" and making sure that the pull-rod of the wing fairing's front section is engaged in the hook of the curtain which is located in the central section of the wing fairing.

When mounting the camera, one must make sure that those parts of the camera, which are mounted on shock absorbers do not touch any parts

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of the aircraft, and that the terminal circuit-breaker cable passes through the beveled slot of the hatch cover.

5. After the aerial camera, the wing fairing, and the plug-and-socket unit have been positioned in their respective places, it is necessary to test whether the mechanism for operating the curtains of the camera window opening is in good working order, by pressing upward on the angular lever arm in the nose of the wing fairing. (the tension of the spring will bring the curtains back to their initial closed position). [p 295]

6. Connect aircraft electric circuit to 27-voltage current and test the performance of the aerial camera in the following order:

a. Switch on the AZS [automatic circuit breaker] of the "AFA-39" on the starboard panel;

b. Set the time interval lever of the remote control device on the 4-second mark (or on the time interval necessary in flight as indicated in the table):

v. Press upwards on the arm of the angular lever, which is located in the wing fairing until the camera window opening curtains open up, and the KV-9A terminal switch becomes engaged.

Keep the mechanism of the curtains in this position during inspection indicated in paragraph "g";

g. Plug in the "AFA" switch, which is located in the middle panel of the instrument board and expose 2-3 frames (cycles).

Then find out whether the film rewinding mechanism is functioning properly (by watching the signal lamp), whether the unexposed frame film counter is working properly (visually), and whether the shutter is performing correctly (by listening);

d. Disconnect the "AFA" switch, and close the blinds of the camera compartment.

7. Test the apparatus; switch the time interval lever to the "16-second position"; plug in the "AFA" switch, open the camera compartment blinds manually all the way down to the terminal switch, [p 296] and let the AFA operating mechanism run until the shutter closes (a click is heard in the aerial camera), and then immediately close the blinds to protect the camera system. Disconnect the "AFA" plug and the AZS of the "AFA-39".

Attention: 1. During routine maintenance, while raising and lowering the landing gear, check the opening the camera window curtains from the landing gear strut, and also check the performance of the interlocking terminal switch. When the camera is out of order or when its performance is unsatisfactory, make a special inspection after setting the aircraft on trestles.

2. If it becomes necessary to temporarily dismantle the camera unit and its fairing, before the rear section of the fairing is removed, the socket of the terminal switch cable plug must be disconnected. The opening under the AFA is closed with a special cap provided with each camera spare-parts set.

Dismantling of the Remote Control Instrument

To dismantle the AFA-39 remote control instrument (routine maintenance etc.), it is necessary:

1. To remove the screws from four brackets which hold down the control instrument to the dashboard;

2. To remove the AFA-39 remote control instrument from the aperture in the panel. [p 297]

3. To disconnect the electric plug and remove the control instrument and its brackets to check its performance according to the prescribed instructions for servicing the AFA-39 aerial camera.

4. To install the AFA-39 remote control instrument back in place, in reverse order, after it has been checked.

CHAPTER V

PREPARING THE AIRCRAFT INSTRUMENTATION FOR FLIGHT

[p 298]

Initial Preparations

Examine and check the following:

Nose Section of the Fuselage

1. The reliability of the mounting and the exterior condition of the Pitot tubes, the cleaniness of the absolute and static pressure chamber openings, and the moisture trap openings.

2. The airtightness of the absolute pressure system from the main Pitot tube at a pressure corresponding to a speed of 1,000 kilometers per hour, and check out readings on the speed indicator with a calibration instrument. The indicator error should not exceed plus or minus 25 kilometers per hour. A similar check of instrument error should be performed at a speed of 300 kilometers per hour. The indicator error should not exceed plus or minus 15 kilometers per hour. The efficiency of the mach-meter is determined by the build up and release of pressure. The air-tightness of the static pressure system from the main Pitot tube is tested by means of a vacuum equivalent to a speed of 700 kilometers per hour. The efficiencies of the variometer and of the altimeter are checked by the build up and reduction in vacuum. The absolute and static pressure systems are airtight if the pointer on the speed indicator drops no more than 5 kilometers per hour during a period of one minute.

[redacted]

3. The efficiencies of the heating elements of the Pitot tubes and of the transducers of the angles of incidence and of slip (to the touch),

Preflight Preparations [p 299]

Examine and check the following:

4. The mounting reliability of the instrument panel.

5. The exterior condition of the instruments and the proper setting of their pointers. Set the index-pointers of the accelerometer on the unit setting.

6. The position and locking of the absolute pressure system switching valve.

7. The cleaniness of the openings of the absolute and static pressure chambers and the moisture trap openings of the Pitot tubes.

8. The efficiency of the aneroid-diaphragm instruments at a pressure and a vacuum in both the absolute and static pressure systems, and the accuracy of the readings of the speed indicator at the 300 kilometer per hour mark on the scale from the main Pitot tube.

9. Check the efficiencies of the master attitude indicator, the turn indicator, the navigational system, the aircraft clock and the heating elements of the Pitot tubes, and the angle of attack and angle of slip transducers.

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Initial Inspection Preparations for Repeat Takeoff

10. Do what should be done to the instruments as indicated in the pilot's check list concerning the operation of the instruments.

11. Check the cleanliness of the openings of the absolute and static pressure chambers and the moisture trap openings of the Pitot tubes.

COCKPIT [p 300]

12. The mounting reliability and the shock absorption of the instrument panel, the mounting and exterior condition of the instruments, and the proper settings of their pointers.

13. Check the efficiencies of: the master attitude indicator, turn indicator, the navigational system, the aircraft chronometers. and the electrical pressure gauges.

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CHAPTER VI

SCHEDULED MAINTENANCE WORK

[p 301]

WORK PERFORMED DURING IDLE PERIODS

Description of Operations	7-10 days	25-35 days	3 mos + 10 days
Air Pressure Systems, Instrument Boards and Panels			
1. Check:			
- the exterior of the moisture traps and drain the condanded water; if necessary, flush the traps with B-70 gasoline and blow out with compressed air			+
- the exterior of the instrument board and control panels, remove dust and dirt from and from behind instrument board			+
- coupling nuts of plug connectors of electrical instruments; exterior and flange of electric bunched conductors			+

(Plus sign + indicates when work performed)

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	7-10 days	25-35 days	3 mos ± 10days
- exterior condition and flange of rubber canvas hose			+
- airtightness of absolute pressure lines from emergency absolute pressure chamber, lock absolute pressure line switch valve in "Operate" position; efficiency of aneroid-diaphragm instruments and airtightness of absolute and static pressure lines from main Pitot tube		+	+
<u>Directional System</u> [p 302]			
2. Inspect the exterior and check the mounting of the system's components			+
3. Check the system's coordinating speeds and magnetic course dial movement		+	+
<u>Converters</u>			
4. Check the mounting of the instrumentation supply converter			+
<u>Instruments Controlling Engine and System Operations</u>			
5. Inspect the exterior condition and the mounting of the instruments and the coupling nuts of the plug connectors of the following:			
- electric pressure gauge transducers			+
- electric tachometer transducers			+

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	7-10 days	25-35 days	3 mos + 10 days
- pressure signal unit			+
- thermocouple housing		+	+
- fuel consumption units			+
- critical fuel supply warning transducer			+

[p 303]

WORK PERFORMED FOLLOWING MISSION

Description of Operations	(Plus sign + when work done after mission) 50 hours, + or -5	100 hours, + or -10
Navigation Instruments		
Aneroid-Diaphragm Instruments, Air Pressure Systems		
1. Remove from the aircraft:		
- speed indicator, mach-meter	+	+
- altimeter, variometer	+	+
- pressure altitude and drop indicator		+
- relay block		+
2. Inspect the exterior of the speed indicator, mach-meter, altimeter, and variometer, and check the:		
- airtightness of the housing	+	+
- smooth motion of pointers and fundamental error during forward and reverse motion. Calculate the difference.	+	+

[p 304]

	50 hours, + or -5	100 hours, + or -10
3. Inspect the exterior of the cockpit-altitude and differential pressure indicator and check the airtightness of its housing, smooth motion of the pointers, the fundamental error during forward and reverse motion, and calculate the difference.		+
4. Inspect the exterior of the relay block and check the airtightness of the housing and the error from operation		+
5. Check the exterior of the rubber canvas hoses	+	+
6. Check for, and if necessary place (renew) identification marks on the rubber canvas hoses and on the connections of the static and absolute pressure instruments	+	+
7. Check the exterior of the Pitot tube moisture traps and drain the water. If necessary, flush the traps with B-70 gasoline and blow out with compressed air.	+	+
8. Blow out the main and emergency lines of the Pitot tubes with compressed air at a pressure of 0.5-1.5 kg/cm^2		+

	50 hours + or -5	100 hours, + or -10
NOTE: 1. Before blowing out the pipes, the absolute and static pressure instruments must be disconnected		
2. Between regularly scheduled maintenance inspection, the air pressure lines should be blown out upon the orders of the section engineer as weather permits		
9. Replace on the aircraft:		
- speed indicator, mach-meter	+	+
- altimeter, variometer	+	+
- pressure altitutde and drop indicator		+
- relay block		+
10. Check attachment and mounting of the aneroid-diaphragm instruments and units, the flanges and connections of the rubber canvas hoses to the instrument and commutator pipes	+	+
11. Check the static and absolute pressure lines from the main and emergency Pitot tubes for leaks, and the efficiency of the aneroid-diaphragm instruments (the inspection should be performed jointly with an aircraft technician at the time the automatic cone control mechanism is checked upon the completion of work on the aircraft by specialists of all services)	+	+

[p 306]

	50 hours, + or -5	100 hours, + or -10
12. Lock the absolute pressure switch-valve in the "operating" position	+	+
<u>Gyroscope Instruments, Clock, Convertors</u>		
13. Remove:		
- the attitude indicator	+	+
- the turn indicator		+
- the correction switch		+
- the directional system components	+	+
- the aircraft clock	+	+
- the convertors		+
<u>NOTE</u>: Before removing the attitude indicator and the turn indicator, be certain there are mounting reference marks on the instrument board and on the faces of the instruments		
14. <u>AGD-1 Master Attitude Indicator</u>		
a) Inspect the exterior of the gyrotransducer and check		
- the running order time	+	+
- caging mechanism operation	+	+
- lateral correction speed	+	+

	50 hours, + or -5	100 hours, + or -10
- /longitudinal correction speed	+	+
- operation of the longitudinal correction switch	+	+
- gyrotransducer stability when correction is disconnected	+	+
- error in maintaining vertical	+	+
- current required by phases	+	+
- d.c. required by transducer	+	+
b) Inspect the exterior of the indicator and check		
- the pitch angle adjustment index position	+	+
- the pitch angle index position	+	+
- non-conformance of miniature aircraft and zero graduations of bank scale	+	+
- error after changing the pitch angle	+	+
- error after changing the roll angle	+	+
- corredtion for pitch angle	+	+
- signal lamp performance	+	+
- current required by the phases	+	+
- d.c. required by the indicator	+	+

[p 307]

The EUP-53 turn indicator	50 hours, + or -5	100 hours, + or -10
15. Inspect the exterior and check		
- the condition of the comutator-brush unit, and the height of the brushes. Clean the comutator and blow out the inside suffface of the instrument with compressed air at a pressure of 0.5 + 1.5 kg/cm^2 (after the plant service period warranty has expired);		+
- current required		+
- sensitivity during a flat turn at angular velocities of 0.6 and 1.5 degrees per second;		+
- error during banks of 15.30 and 45 degrees at angular velocities of 1.1, 2.2, and 4 degrees per second;		+
- the time required for the sliding index to return from end positions		
- stop of the sliding index.		

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	50 hours, + or -5	100 hours, + or -10
<u>Navigational system</u>		
16. Examine the exterior of the following units and components and check:		[p 308]
<u>The U-12 amplifier</u>		
- channel I sensitivity and output		
- channel II output		
<u>The U-18 amplifier</u>		
- pitch channel sensitivity and output		
- roll channel sensitivity and output	+	+
<u>The gyroscope unit</u>		
- efficiency of the servomechanisms to perform the roll and pitch rotation	+	+
- departure of the gyroscope axis in the aximuth	+	+
- transducer selsyn error	+	+
<u>Matching Mechanism</u>		
- matching speed	+	+
- correction speed	+	+
- tachometer generator signal	+	+
<u>Course indicator</u>		
- error of the course-measuring scale	+	+
- error of the radio station course angle scale	+	+
- magnetic course dial matching speed and pointer movement	+	+

	50 hours, + or -5	100 hours, + or -10
Correction Mechanism		[p 309]
- efficiency	+	+
- matching speed	+	+
Induction transducer		
- error	+	+
Control panel		
- efficiency	+	+
Correction switch		
17. Examine the exterior and check the current required by each phase, the correction cutoff delay time and its asymmetry.	+	+
Aircraft clock		
18. Examine the exterior and check the accuracy of the daily movement and, if necessary, make adjustments.	+	+
DAG-1F and DT-500U convertors		
19. Examine and check:		
- the condition of the commutator-brush unit and the height of the brushes. Clean the commutator and blow it out with compressed air at a pressure of 0.5 - 1.5 km/cm^2		+

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	50 hours, + or -5	100 hours, + or -10
- the current required by the convertors under load;		+
- the convertor voltage discharge output and its frequency		+
20. Install the following on the airplane:		[p 310]
- master altitude indicator	+	+
- turn indicator;		+
- correction switch:		+
- navigational system units;	+	+
- aircraft clock;	+	+
- convertor.		+
NOTE: When the electric navigation instruments are installed on the aircraft, check the condition of the contact surfaces and plug-and-socket connectors. When necessary clean and blow them out with compressed air.		
21. Check the proper mounting and attachment of the electric navigation instruments, the tightening of the coupling nuts of the plug-and-socket connectors.	+	+

	50 hours, + or -5	100 hours, + or -10
22. Check the efficiency of the electric navigation instruments and of the correction cut-off switch.	+	+
<u>Instruments Controlling Engine and System Operations</u>		
23. Remove the following:		
- electric tachometer indicator and transducers		+
- thermo-electric thermometer indicator		+
- electric pressure gauge indicators and transducers; [p 311]		+
- flow meter unit;		+
- pressure indicators		+
<u>Electric Tachometer</u>		
24. Examine the exterior and check:		
- the ease of pointer movement and the basic error of the unit;		+
- pointer approach to zero mark		+
- interphase voltage of the transducers		+
<u>Thermo-electric Thermometer</u>		
25. Examine the exterior of the indicator and check the ease of pointer movement and the basic error of the unit		+

	50 hours, + or -5	100 hours, + or -10
26. Inspect the exterior and check the attachment of the connecting socket, the bolt nut tightening, the flange and heat insulation of the connecting electric wires of the thermocouples	+	+
27. Measure the resistance of the thermal electrodes of each thermo-couple from the connecting socket	+	+
Electrical Pressure Gauges		
28. Examine the exterior of the gauges and check:		
- the ease of movement of the pointers and the basic error of the unit;		
- air-tightness of the receiver end of the transducers		
Pressure Indicators		[p 312]
29. Examine the exterior and check the following:		
- error of operation		+
- airtightness of the receiving section		+
Flow Gauge		
30. Examine the exterior of the units of the set and check:		
- the main error of the set;		+
- the operational error of the signal unit		+

31.

	50 hours, + or -5	100 hours, + or -10
Install the following on the aircraft:		
- indicator and transducer of the electrical tachometer		+
- indicator of the thermoelectric thermometer;		+
- indicators and transducers of the electric pressure gauges;		+
- flow gauge set;		+
- pressure signal units		+
NOTE: 1. Before installing the engine operation control instruments on the aircraft, check for and if necessary place (restore) marks on the instruments indicating the limitations of performance of the engine and systems.		
2. When installing the instruments which control the operations of the engine and the systems examine the condition of the plug-and-socket connectors and contacts. If necessary, clean and blow them out with compressed air.		

	50 hours, + or -5	100 hours, + or -10
		[p 313]
32. Check the proper mounting and attachment of the instruments which control the operations of the engine and the systems, and the tightening of the lock nuts of the plug-and-socket connections.	+	+
33. Check the efficiency of the instruments controlling the operations of the engine and systems during engine tests (jointly with an aircraft and engine mechanic)	+	+
Instrument Board and Control Panel		
34. Examine the exterior of the instrument board and control panels and check: - the attachment and the condition of the shock absorbers of the instrument board; the condition and tightening of of the guide bolts and rods (if necessary, lubricate the guide bolts and the rods with TSIATIM 201 grease).	+	+
35. Remove dust and dirt from the instrument board and from the compartment behind the instrument board	+	+
36. Install the instrument board in place and make sure that it is fastened down tightly.	+	+

	50 hours, + or -5	100 hours, + or -10
37. Examine the exterior and check the proper mounting of the air pressure gauges	+	+
<u>Pilot's Automatic Safety Belt Opener</u>		[p 314]
38. Check the hose and wire cable; make sure that the cable terminals are not sheared, that there are no breaks in individual strands of the wire-rope cable, and that there is no damage to the hose. Examine the exterior of the instrument.	+	+
39. Dismantle the pull-off mechanism, wash the parts in B-70 gasoline, wipe with a soft brush, and blow out with dry air. Examine the parts of the mechanism, and make sure that they are neither broken nor corroded.	+	+
40. The operating springs and the piston with the roller should be lubricated with a thin layer of OKB-122-3 oil, and the wire cable and the hose with a thin layer of MVN oil.	+	+
41. Check the exact time it takes the instrument to work.	+	+

PART FOUR

[P 315]

OXYGEN EQUIPMENT

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OXYGEN EQUIPMENT [P 316]

CHAPTER I

I. GENERAL INFORMATION

A. THE OXYGEN SUPPLY OF THE PILOT

For creating the necessary living conditions for the pilot and for preservation of his efficiency, both in high altitude flights and in ejections, a KKO-3 oxygen equipment unit has been installed in the aircraft (figure 84).

The KKO-3 unit provides differential oxygen pressure in the pressurized helmet (the breathing system) and in the bladder of the stress arrangement of the G-suit, which is automatically regulated by the altitude of the aircraft.

The KKO-3 oxygen equipment unit consists of:

a) aircraft oxygen equipment

b) pilot's oxygen equipment

Aircraft oxygen equipment includes:

1. KP-34 aircraft oxygen apparatus .... 1 unit
2. KR-26 oxygen regulator .... 1 unit
3. IK-18 oxygen indicator .... 1 unit [P 317]
4. M-2000 reserve pressure gauge .... 1 unit
5. KV-2MS oxygen valve .... 1 unit
6. KSh-26 oxygen hose assembly .... 1 unit
7. RSD-3M pressure ratio regulator .... 1 unit
8. DU-2 remote control board with KP-34 apparatus .... 1 unit

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9. Set of fittings .... 1 set

The pilot's oxygen equipment includes:

1. KP-27M parachute oxygen apparatus with turn-on device .... 1 unit

2. GSh-4M pressurized helmet (with hose assembly, connecting hose and electrically heated windshield) .... 1 set

3. KM-30M oxygen mask .... 1 set

4. VKK-3M G-suit .... 1 set

Figure 84. Overall and Assembly Diagrams of the Pilot's Oxygen Supply [P 318]

a. Overall diagram

b. Operation diagram of the ORK-2 disconnect assembly

c. At the time of ejection

d. From the pilot

e. On the seat

f. In the cockpit

g. Operating position

h. To the fuselage structure

i. View of remote control board

j. Turn-off

k. Turn-on

l. Suit

m. 100 percent oxygen

n. All the way

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Figure 84. OVERALL AND ASSEMBLY DIAGRAM OF PILOT'S OXYGEN EQUIPMENT

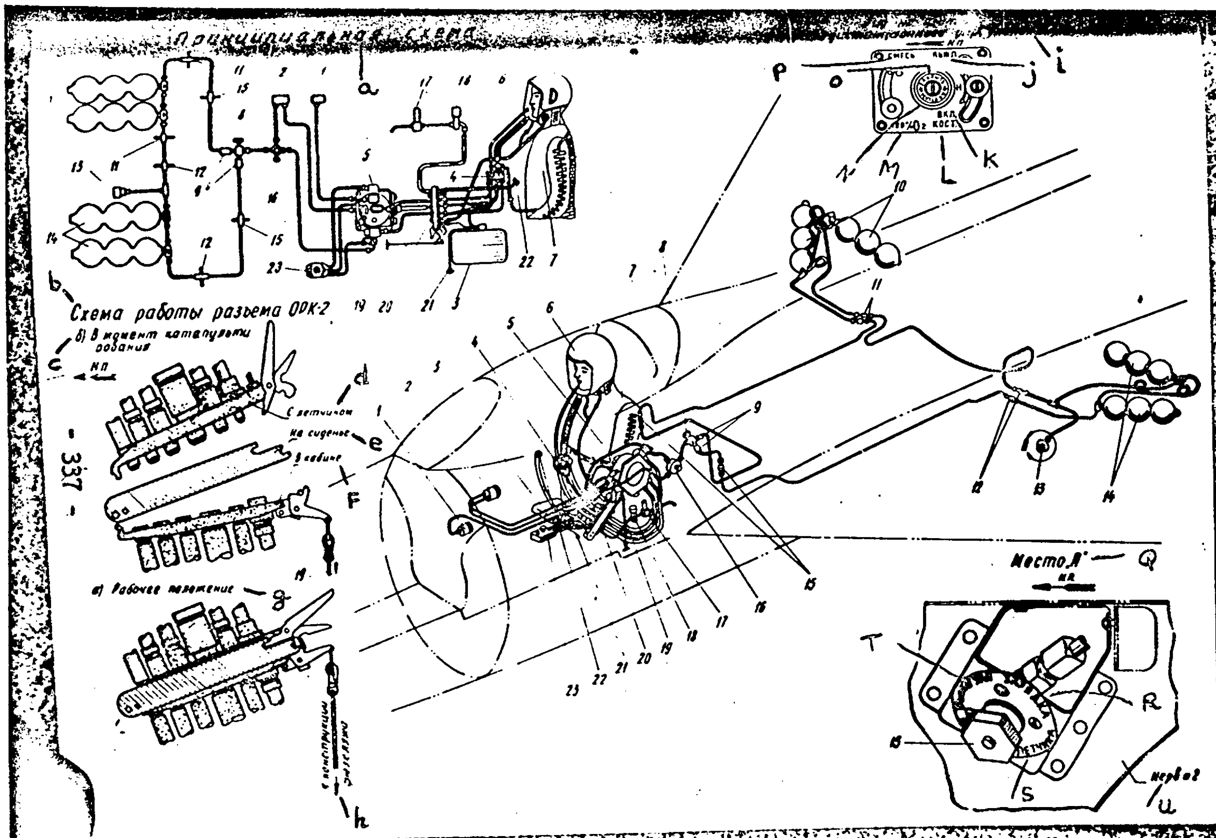

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Рис. 84. Принципиальная и монтажная схема кислородного питания летчика.

o. Close

p. Mixture

q. Point "A"

r. [Illegible]

s. Pilot's

t. [Illegible]

u. Wing rib No 2 [obscure]

Figure 84. Overall and Assembly Diagrams of the Pilot's Oxygen Supply [P 319]

1. M-2000 Pressure guage
2. IK-18 indicator
3. KP-27M parachute apparatus
4. RSD-3M pressure ratio indicator
5. KP-34 oxygen apparatus
6. GSh-4M pressurized helmet
7. VKK-3M G-suit
8. KV-2MS oxygen valve
9. Check valve

10, 14. Spherical oxygen tanks

11, 12, 15. Connection sleeves

13. Filler sleeves
16. KP-26 reducer
17. AD-5 filter
18. AD-5A automatic pressure control

19. Disconnect assembly lower unit emergency lever cable
20. ORK-2 disconnect assembly
21. KP-27M manual turn-on device
22. TsPU easy-disconnect connector coupling
23. DU-2 remote control (with KP-34 apparatus)

A PPU anti- device, consisting of 2 foot bladders connected with a belly bladder, is built into the VKK-3M. pressurized suit. The anti-gravity device reduces the effect of positive g-forces which have developed in the maneuvering of the aircraft. [P 320]

The air in the anti-device comes from the engine compressor through the AD-5A pressure control which is installed in the cockpit (figure 85).

Depending on the intensity of the positive g-force affecting the AD-5A, the device automatically regulates the air pressure in the bladders of the PPU. Air entry into the bladders of the PPU takes place with a positive force of 2 g and gradually increases with increased loads up to 8 g. With less than 2 g, pressure is not generated in the compartments of the PPU.

The AD-5A pressure control has 2 pressure stages: stage one is low pressure - "min"; stage two is high pressure - "max". Placement of the control knob on high or low pressure depends on the type of pressurized suit used by the pilot.

With the use of the PPK-I anti-gravity suit and the VKK-3M G-suit the control knob is to be placed on low pressure "min", as switching the knob to "max" with the above suits may injure the pilot.

Figure 85. Overall Diagram of the PPU System [P 321]

a. Overall diagram of the PPU system

b. To the suit

c. Air from the engine

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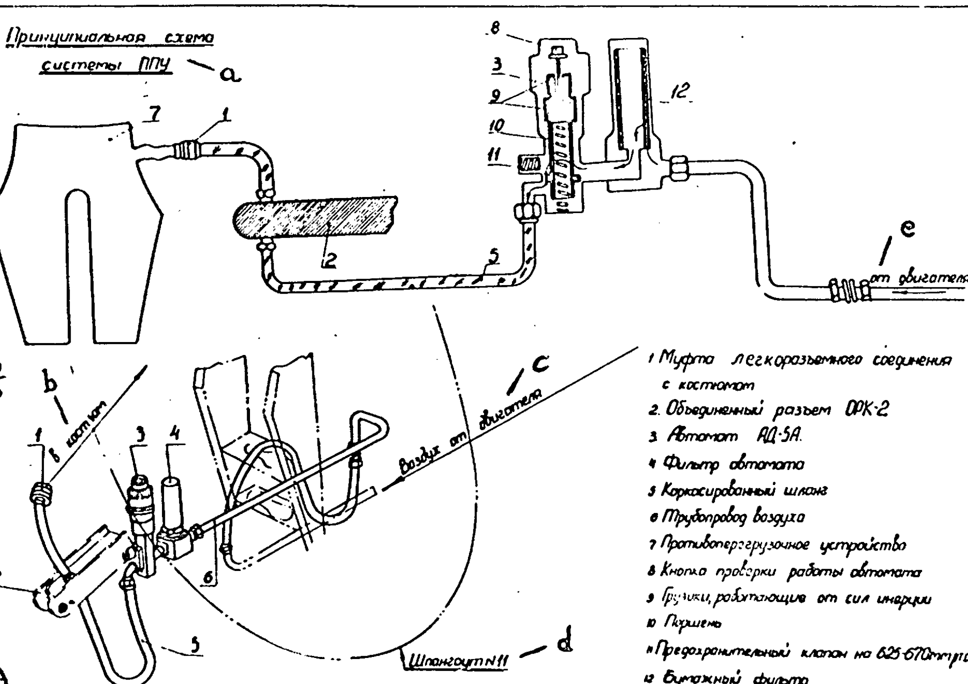

Figure 85. Overall Diagram of the PFU System

Рис. 85. Принципиальная схема системы ППУ.

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d. Rib No 11

e. From the engine

1. Easy-disconnect connection coupling with suit

2. ORK-2 disconnect assembly

3. AD-5A automatic control

4. Filter of the automatic control

5. Reinforced hose

6. Air line

7. Anti-device

8. Control button for checking the operation of the automatic control

9. Inertia flyweights

10. Piston

11. Safety valve at 625-670 mm Hg

12. Paper filter

Switching the controls to "max" or "min" is accomplished by turning the control knob in the direction shown by the arrows on the control knob. [P 322]

ATTENTION! 1. In flights up to altitudes of 7 kilometers, the oxygen equipment unit can be used without the G-suit both in pressurized and non-pressurized cockpits, but the anti-gravity suit must be used. For this purpose, the bayonet fastener on the hose of the RSD-3M pressure regulator, which connects to the suit, should be closed with the plug.

2. The KM-30M ovygen mask of the KKO-3 unit can be used in flights of not over 12 kilometers in altitude.

Hoop-up of the lines of the pilot and the aircraft is accomplished by means of the ORK-2 disconnect assembly (figures 86 and 87), which is located on the port side of the seat bucket.

[redacted]

[redacted]

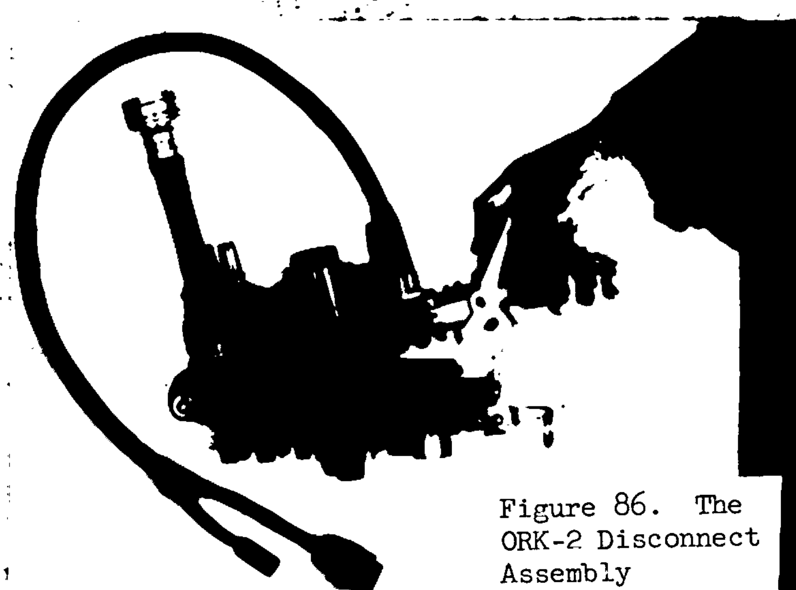

Figure 86. The ORK-2 Disconnect Assembly

[illegible] ОРК-2

[redacted]

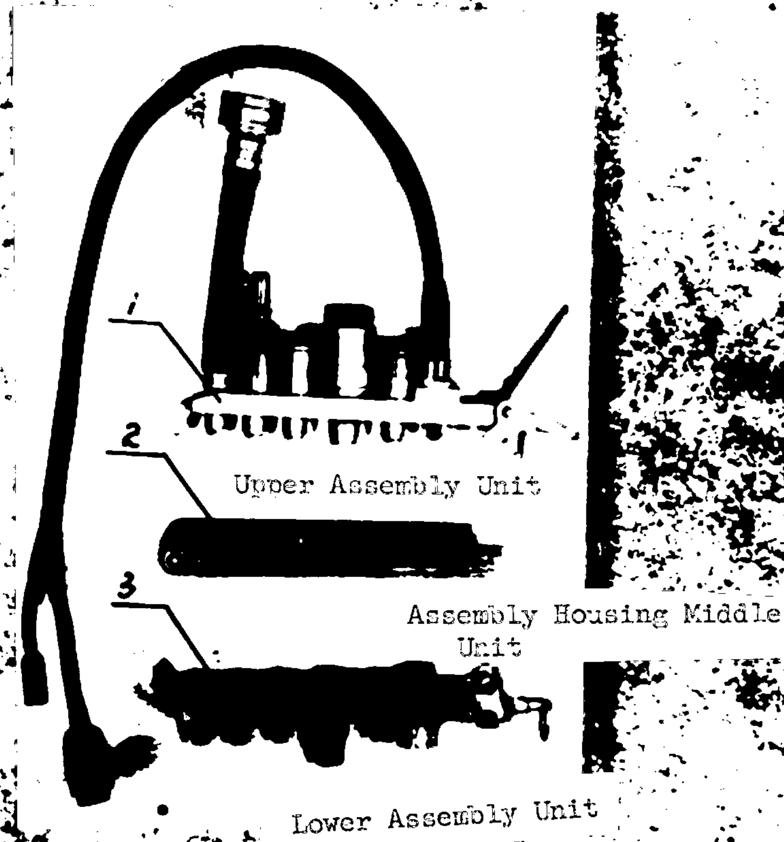

Figure 86. Disassembled View of the ORK-2 Disconnect Assembly

Фиг. 87. Объединенный раз"ем коммутационный ОРК-2 в разомкнутом виде.

1 – верхняя колодка раз"ема
2 – корпус раз"ема /средняя колодка/
3 – нижняя колодка раз"ема

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The ORK-2 provides simultaneous automatic or manual disconnection of all hoses leading from the aircraft's apparatus to the pilot and also automatically switches the pilot's oxygen supply from the KP-34 aircraft apparatus to the KP-27M parachute apparatus in case of ejection.

Operating Principle of the KKO-3 Unit

The oxygen which enters the oxygen supply system is contained in 4 spherical cylinders under a pressure of up to 150 kilograms per square centimeter. Two oxygen cylinders are located in each wing.

Figure 86. The ORK-2 Disconnect Assembly [P 323]

Figure 87. Disassembled View of the ORK-2 Disconnect Assembly [P 324]

1. Upper assembly unit
2. Assembly housing middle unit
3. Lower assembly unit

At altitudes up to 12 kilometers, the intake of oxygen into the pressurized helmet is provided for by the automatic air valve of the KP-34 apparatus. At altitudes up to 10 kilometers a mixture of oxygen and air is furnished; above 20 kilometers pure oxygen is supplied. [P 325]

To prevent an oxygen deficiency at altitudes of 6 to 12 kilometers, a small surplus pressure is maintained in the respiratory system, which eliminates air induction from the atmosphere into the pressurized helmet should it be leaking.

In all cases, where the cockpit pressure is less than that of the atmosphere, at an altitude of 12 kilometers (145 mm Hg) a continuous supply of oxygen will be pressure fed into the bladders of the G-suit pressure unit. The increase in the supply of oxygen will be automatically regulated by the RSD-3M pressure ratio regulator depending on the altitude of the aircraft. This means that if the pilot is in a pressurized cockpit at any altitude up to ceiling, or is in a non-pressurized cockpit up to altitudes of 12 kilometers, the bladders of the G-suit will not be inflated with oxygen (not including the anti-device). This will provide great pilot maneuverability.

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In non-pressurized cockpits at ceilings of more than 12 kilometers altitude a continuous supply of oxygen is automatically fed into the G-suit and into the breathing system (pressurized helmet). The oxygen pressure in the pressure unit of the suit produces a mechanical pressure on the body of the pilot which compensates for the drop in atmospheric pressure. [P326]

Differential pressure in the pressurized helmet and in the bladder of the G-suit pressure unit is regulated by the RSD-3M automatic pressure ratio regulator depending on the altitude.

Inflation of the bladders of the suit pressure unit and supply of oxygen to the pressurized helmet is accomplished by the KP-34 aircraft oxygen apparatus; after ejection, by the KP-27M apparatus.

The KKO-3 unit is supplied by a manually regulated apparatus which at ground level permits the creation of excess pressure in the pressurized helmet and in the G-suit pressure unit for the purpose of checking the operation of the unit.

Main Specifications of the KP-34 Apparatus (Figure 88)

1. The apparatus operates on oxygen fed to it by the KP-26 regulator at pressures of from 150 to 30 kilograms per square centimeter.

Figure 88. KP-34 Oxygen Apparatus [P 327]

a. View of side A

b. Base

c. Cover

d. Note: All tubes and couplings of the apparatus are shown plugged.

e. Apparatus housing

1. Connection Sleeve for KSh-26 Oxygen Hose

2. Adapter for attaching oxygen indicator

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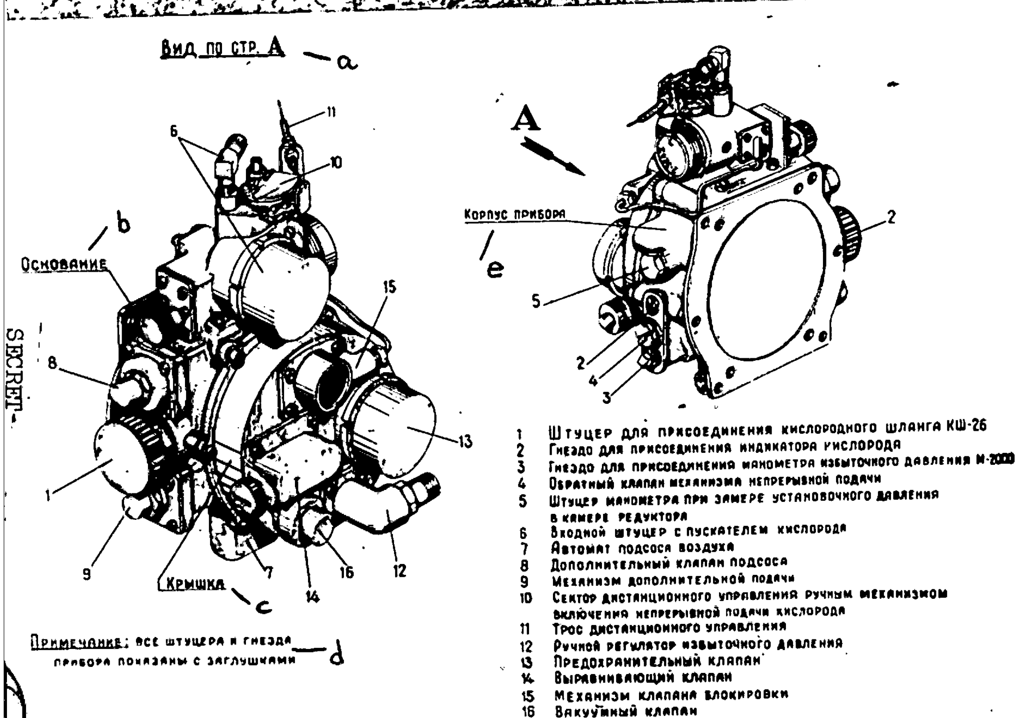

Figure 88 KP-34 Oxygen Apparatus

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3. Adapter for connecting M-2000 excess pressure gauge

4. Continuous feed mechanism check valve

5. Pressure gauge connector for measuring the set pressure in the reducer chamber

6. Intake tube with oxygen release fitting

7. Automatic air intake control

8. Auxiliary intake valve

9. Auxiliary supply mechanism

10. Sector for the remote control of the manual mechanism for switching on continuous oxygen supply switch-on

11. Remote control cable

12. Excess pressure manual regulator

13. Safety valve

14. Compensation valve

15. By-pass valve mechanism

16. Vacuum valve

2. The high pressure chamber and automatic air valve are pressurized by supplying a pressure of 30 kilograms per square centimeter to the apparatus. [P 328]

3. By supplying a pressure of from 6 to 80 kilograms per square centimeter to the apparatus, the adjustable (static) pressure in the apparatus regulator is 8 to 6 kilograms per square centimeter.

4. The automatic air valve is opened when the pressure in the chamber regulator is 7-15 kilograms per square centimeter.

5. The jet nozzle opens when the pressure is from 1.9 to 2.3 kilograms per square centimeter.

6. The low pressure chamber of the apparatus is pressurized by:

a) a vacuum in the apparatus of 100 mm of H_2O (which allows air induction at a rate of not more than .8 [obscure] liters per minute);

b) a pressure in the apparatus of 1800 mm H_2O (which permits oxygen leakage of not more than 1.5 liters per minute).

7. A continuous supply of oxygen of 14 to 20 liters per minute is fed into the apparatus at a pressure of 10 kilograms per square centimeter.

8. The manual control admits pressure of 10 kilograms per square centimeter at ground level which creates an excess pressure in the apparatus of not more than 1800 mm H_2O.

9. The force for switching on the continuous supply to the suit does not exceed 4.5 kilograms [per square centimeter].

10. The time required for attaining the differential pressure in the pressurized helmet of 1200 mm H_2O does not exceed 3.5 seconds from the moment the continuous supply is turned on.

KP-27M Parachute Oxygen Apparatus (Figure 89)

The KP-27M parachute oxygen apparatus is used in a unit with the KP-34 aircraft oxygen apparatus for supplying oxygen to the pilot under the following conditions: [P 329]

a) ejection from the aircraft; or

b) regaining a safe altitude (4000 meters) in the event of non-operation of the KP-34 aircraft oxygen apparatus at high altitude flight.

The KP-27M apparatus is put in the container of the parachute back-pack with the front in such a position that the opening of the mechanism (the cable which connects to the ORK-2 connector) is set to the port side in relation to the pilot, who is fitted in the parachute.

The apparatus is supplied with oxygen and operated in accordance with the "Description and Instructions for Operation of the KP-27M Apparatus."

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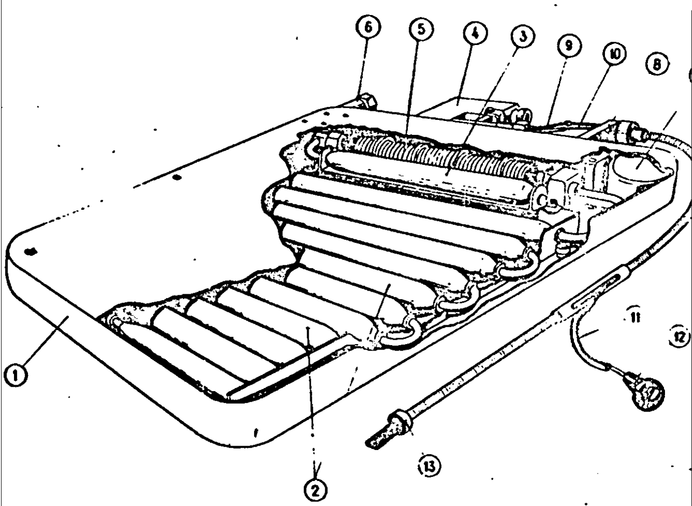

1 Корпус
2 Батарея баллончиков
3 Дополнительный баллончик
4 Пускатель
5 Капиллярная трубка
6 Зарядный штуцер
7 Манометр МК-12М
8 Колодка крепления
9 Тросик автоматического включения прибора
10 Тросик ручного включения прибора
11 Трубка
12 Рукоятка ручного включения прибора
13 Накидная гайка для присоединения к ОРК-2

Фиг. 93. Парашютный кислородный прибор КП-27М.

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Main Specifications of the KP-27M Apparatus

1. The parachute oxygen apparatus is used in a unit with the KP-34 aircraft oxygen apparatus.

2. At a temperature of plus 20 degrees centigrade, the apparatus supplies oxygen in one minute after being turned on at a rate of not less than 12.5 liters per minute and in 2 minutes at a rate of not less than 5 [obscure] liters per minute.

Figure 89. KP-27M Parachute Oxygen Apparatus

1. casing [P 330]
2. Bottle set
3. Auxiliary bottle
4. Release cock
5. Capillary tube
6. Filler tube
7. MK-14M pressure gauge
8. Fitting block
9. Automatic switch-on cable
10. Manual switch-on cable
11. Tube
12. Manual switch-on handgrip
13. Nut for connection to ORK-2

At a temperature of minus 50 degrees centigrade, in 30 seconds after the apparatus has been turned on oxygen is supplied at not less than 9 liters per minute. [P 331]

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The supply of oxygen is smooth, without abrupt pressure jumps.

3. In not more than 15 seconds, the apparatus fills the pressure unit of the G-suit with oxygen at a pressure of one kilogram per square centimeter.

4. The high pressure chamber of the apparatus is pressurized at 150 kilograms per square centimeter.

Filler valve oxygen leakage of not more than one liter per minute is assumed, but unscrewed plug leakage is not permitted.

5. The apparatus is turned on after the cable pin of the automatic switch has been pulled out, either automatically or manually.

6. The low pressure chamber of the apparatus is pressurized at 2 kilograms per square centimeter. Oxygen leakage, characteristic of a pressure drop, is not to exceed 0.4 kilograms per square centimeter per minute.

B. ENGINE OXYGEN SUPPLY

An engine oxygen supply system has been installed in the aircraft to provide reliable fuel combustion when starting the engine at altitudes up to 12,000 meters.

The engine oxygen supply system includes the following units: (figure 90) [P 332]

- a 2-liter oxygen bottle with a pressure of up to 150 atmospheres is installed in the area of No 17-18 frame members in the lower part of the fuselage.

- a "2130A" oxygen reducer, which reduces the pressure of the oxygen to 9-10.5 atmospheres, is installed on the left side of the fuselage in the area of frame members No 12 and 13.

- an "11180" aircraft filler tube and MK-12M high pressure gauge are installed in the lower left wing.

- an MK-16 low pressure gauge and a KV-2MS oxygen supply valve are located on the left panel of the cockpit.

- a "694400" electropneumatic valve is installed next to the oxygen tank and is used for supplying oxygen to the igniters.

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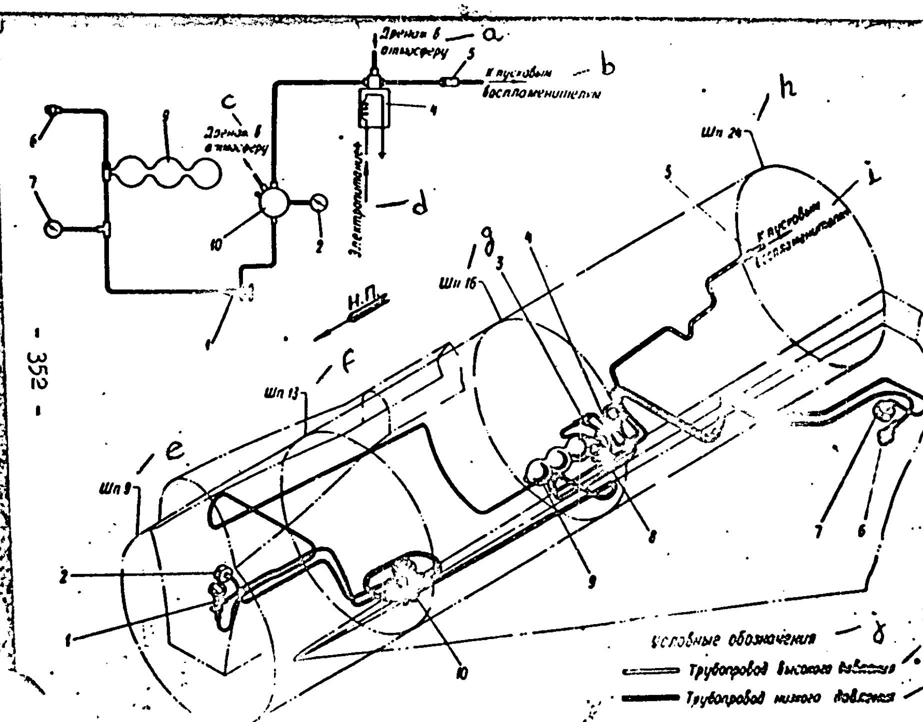

Figure 90. Engine Oxygen Supply Diagram

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The engine oxygen supply system is self-contained and is not connected to the pilot's oxygen supply system. A check valve installed on the engine connects it with the system.

The system automatically starts the engine in the air. A "start in the air" switch located on the left panel provides electric power to the system.

Figure 90. Engine Oxygen Supply Diagram [P 333]

a. air bleeder

b. to the igniters

c. air bleeder

d. electrical supply

e. frame member No 9

f. frame member No 13

g. frame member No 16

h. frame member No 24

i. to the igniters

j. legend

k. high pressure pipelines

l. low pressure pipelines

Figure 90. Overall and Assembly Diagrams of the Engine Oxygen Supply [P 334]

1. KV-2MS oxygen valve

2. MK-16 pressure gauge

3. T-joint

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4. 694400 electropneumatic valve

5. check valve

6. "11180" aircraft filler connection

7. MK-12M pressure gauge

8. T-joint with check valve

9. oxygen bottle

10. "2130A" oxygen reducer

The system does not operate during ground starts of the engine. [P 335]

The engine oxygen supply system is capable of 4-5 starts, with a duration of one start not to exceed 30 seconds.

2. PRECAUTIONARY MEASURES

1. It is necessary to remember that combining oxygen with oils (greases) is dangerously explosive.

2. It is prohibited to open the KV-2MS valve in the cockpit under the following conditions:

- during engine mothballing;

- without preliminary warm-up testing of the engine after a long layover;

- after de-mothballing the engine without preliminary warm-up testing.

3. It is prohibited to leave the check valve tubing and plugs open when replacing the engine.

4. It is prohibited to bleed oxygen by the regulator either in the cockpit or in the radioelectronic equipment compartment.

In case of the necessity to bleed oxygen from the system, it is recommended to do so by disconnecting the tubing from the MK-12M high pressure gauge.

5. It is prohibited to tighten the tubing connection of the open KV-2MS valve when the system has been filled.

Figure 91. RSD-3M Suspension and Cable Arrangement for Disconnection of the ORK-2 Disconnect Assembly Upper Section [P 336]

a. RSD-3M pressure ratio regulator with hose assembly

b. Spring hook

c. Pilot's seat

d. RSD suspension

e. ORK-2 upper section disconnection cable

f. ORK-2

g. View of side B

h. Lever

Figure 91. RSD-3M Suspension and Cable Arrangement for Disconnection of the ORK-2 Disconnect Assembly Upper Section

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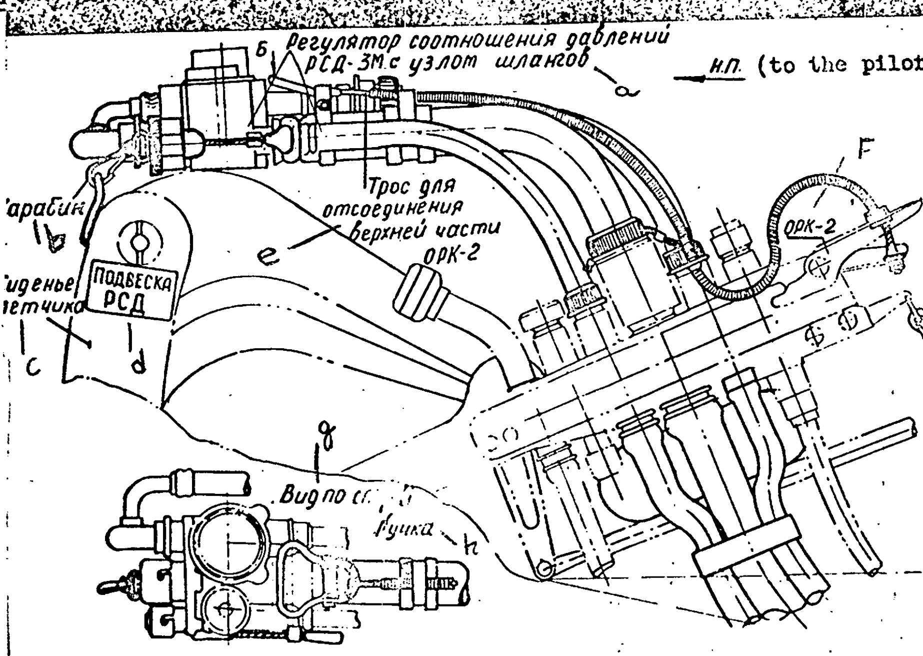

...91. Подвеска РСД-3М и установка троса для отсоединения верхней части объединенного разъема ОРК-2.

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CHAPTER II

OPERATION OF OXYGEN EQUIPMENT

[P 337]

Operation of oxygen equipment and preparation of the aircraft on the ground require the following:

1. For the purpose of rapid separation of the ORK-2 disconnect assembly when the pilot abandons the aircraft in emergency on the ground, on the ORK-2 opener handle there is a cable, which is fastened in holders to the hose of the pressure-ratio regulator.

For disconnecting the upper unit of the assembly, the pilot must pull the cable with his hand and thus, the upper part of the unit is disconnected (See Figure 91).

2. For protecting the pilot from being hit by the ORK-2 upper unit during ejection (after separation), it is necessary, after the pilot has seated himself, to fasten the upper unit to the parachute straps with capron suspension brackets and a rubber shock absorber (Figure 92). Fastening is carried out as follows:

a) The engineer of the aircraft (after the pilot has seated himself) must install the capron suspension brackets, fastened under the third sleeve of the upper unit of the assembly, to the end of the leg grip (from the left side) without fouling the hose, and close the snap over the ring on the suspension bracket.

[P 339]

b) Taking the free end of the suspension bracket, tighten them as much as

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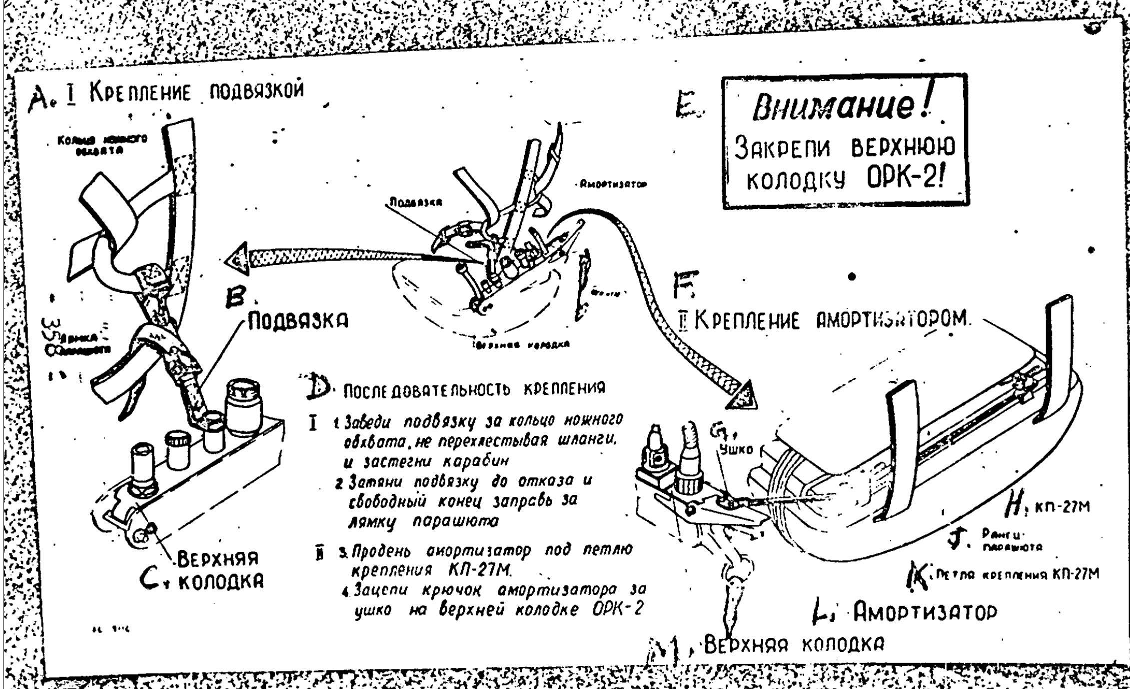
Figure 92. Suspension Brackets of the Upper Block of the ORK-2 Assembly



Фиг. 92. Подвязка верхней колодки разъема ОРК-2.

Key, Figure 92. Suspension brackets of the Upper Block of the ORK-2 Assembly [P 338]

A. Fastening of suspension brackets

B. Suspension brackets

C. Upper units

D. Steps to fasten:

I. 1. Bring suspension brackets to the end of the leg grip and fasten the hooks.

2. Tighten suspenders as much as possible and attach free end to strap of parachute.

II. 3. Pass shock absorber under the fastening buckle for the KP-27M.

4. Fasten hooks of shock absorber to lug on upper block of ORK-2.

E. Attention! Fasten upper unit of ORK-2

F. Fastening of shock absorber

G. Lug

H. KP-27M

J. Parachute pack

K. Buckle for fastening the KP-27M

L. Shock absorber

M. Upper unit

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[P 339]

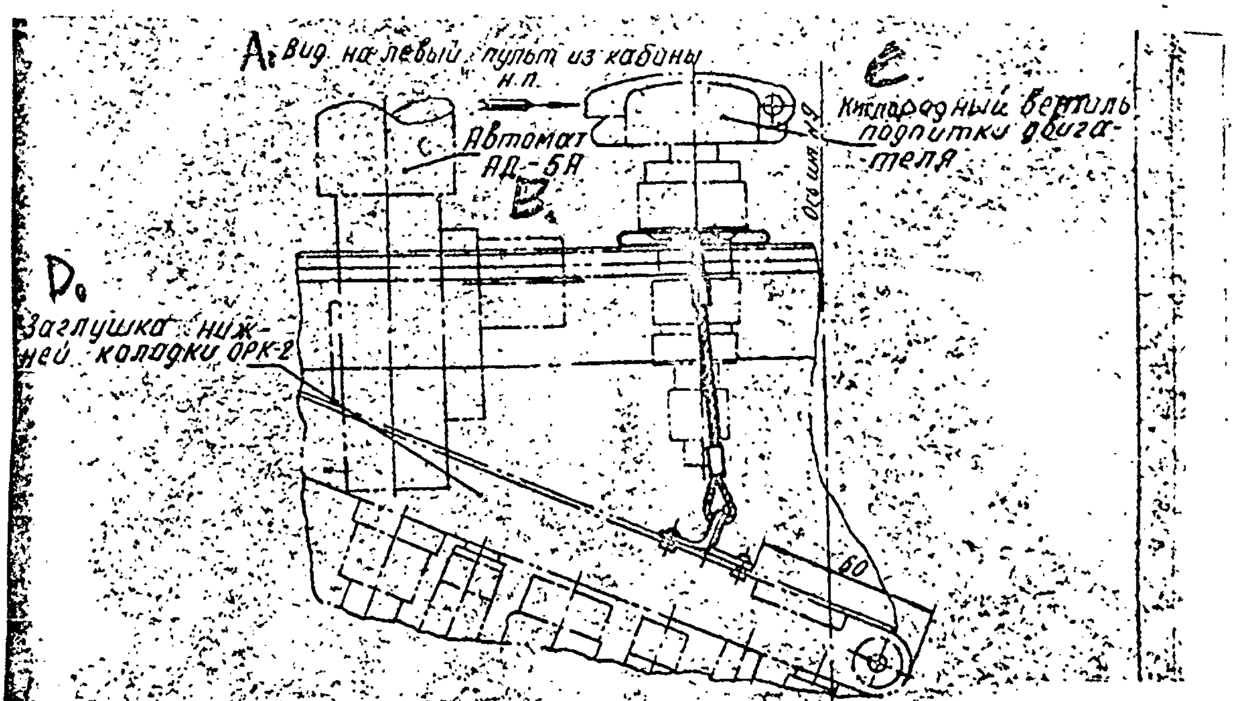
Key, Figure 93. Fastening of Lower Unit of the ORK-2 to the Left Panel of the Cockpit by Means of a Flange

A. View to left panel from cockpit

B. AD-5A automatic

C. Engine feed oxygen valve

D. Flange of lower unit of ORK-2



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[redacted]

possible, after which attach the free end to the strap of the parachute.

V) Passing the rubber shock absorber under the buckle for fastening the KP-27M, engage the hooks of the shock absorber in the buckle on the upper unit of the ORK-2 assembly.

3. When the aircraft is being prepared on the ground, in the event of removal of pilot's seat, fasten the lower part of the ORK-2 assembly with the flange to the left panel of the cockpit as per Figure 93.

4. To assure comfort during operation in the cockpit and to protect cockpit equipment during ground preparation of aircraft and during stops, a pressure regulator RSD-3M (with hoses) has been installed, behind the seat of the pilot. (See Figure 91).

The RSD-3M is mounted by means of a hook on the flange of the regulator by taking hold of the bracket on the front left of the seat.

The engineer of the aircraft must remove the flange of the RSD-3M with its hook before flight, until the pilot's pressurized helmet has been put on. The flange is replaced and the RSD-3M remounted immediately after flight.

5. In the event of need for rapid abandonment of the aircraft [P 340]
when ditched in water, or on the ground (in case of fire), pressure regulator RSD-3M is provided with an emergency group disconnect assembly.

To open the emergency group disconnect assembly of the RSD-3M, it is necessary to free the handle of the assembly on the housing of the RSD-3M and,

[redacted]

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to pull the pin from the openings by tugging on it forcefully.

Opening of the emergency ~~xxxxxxx~~ disconnect assembly assures blocking off of the hoses of the pilot's high-altitude equipment (helmet), G-suit, and the catch with which regulator is fastened to the suspension system of the parachute) from the aircraft equipment.

After opening the emergency disconnect assembly of the RSD-3M, the pilot must open the central lock of the parachute suspension system and must abandon the aircraft cockpit.

WARNING: Opening of the emergency disconnect assembly of the RSD-3M during emergency bail-out from the aircraft in flight is <u>PROHIBITED</u>!

In contrast to the handle for opening the ORK-2 disconnect assembly (See Figure 91), the emergency group assembly of the RSD-3M is designed for abandoning the aircraft without a parachute.

6. For ease of using the handles that control the aircraft oxygen equipment, remote control is provided from KP-34 the DU-2 instrument board installed on the left panel. (See Figure 94)

7. To counter sweating in above-zero temperatures and freezing [P 342]
in below-zero temperatures, electric heating of the helmet glass is provided. Regulation of the degree of heating of the glass is accomplished manually with the aid of the RKO-45 potentiometer installed on the left panel.

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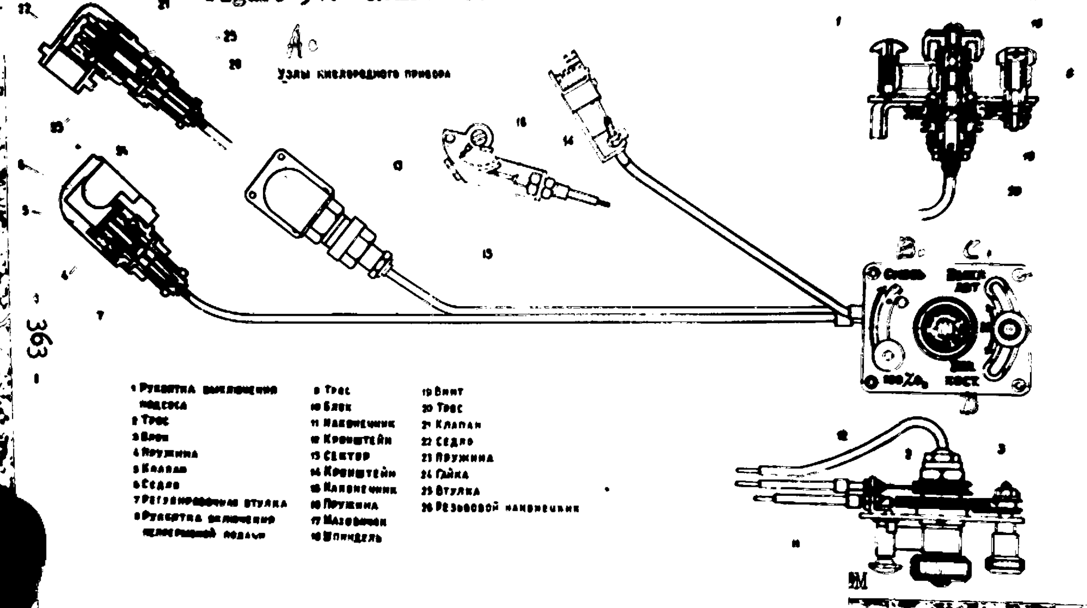
Figure 94. Remote Control DU-2



Фиг. 94. Дистанционное управление ДУ-2.

Fig. 94. Remote Control DU-2

Key to Figure 94. Remote Control DU-2 [P 341]

A. Oxygen equipment units

B. Mixture

C. Automatic Turn-Off

D. Suit Turn-On

1. Intake disconnect handle
2. Cable
3. Block
4. Spring
5. Valve
6. Valve seat
7. Regulating bushing
8. Handle for turning on continuous intake
9. Cable
10. Block
11. Nozzle
12. Mount
13. Sector
14. Mount
15. Nozzle
16. Spring
17. Pilot wheel
18. Spindle
19. Screw
20. Caole
21. Valve
22. Valve seat
23. Spring
24. Nut
25. Bushing
26. Threaded nozzle

The handle of the potentiometer is set by the pilot in a position corresponding to the temperature in the cockpit.

For temporary heating of the glass, there is a button on the left panel with the legend "Rapid Heating of Helmet."

1. CHECKOUT FOR LEAKAGE OF THE PILOT'S OXYGEN SUPPLY SYSTEM [P 342]

Checkout for leakage of the oxygen equipment is to be carried out as follows:

a) Check for leakage of the high pressure system by opening valve KV-2MS and closing it as soon as the system is full of oxygen.

If the pointer of indicator IK-18 remains fixed for at least 2 minutes, the system is leakproof. If the pointer reading drops, there is leakage in the system. In this event, it is necessary to find the oxygen leakage point by using of soap suds.

WARNING: The pilot wheel of valve KV-2MS has a reversible handle, which may be used only to open the valve. It is forbidden to use the reversible handle to close the valve, because application of great force may cause the valve to go out of order.

[Original page 343 is missing at this point.]

... upper unit of the ORK-2, close manually the discharge central [P 344] opening of the upper unit of the disconnect assembly and make a shallow inhalation. If it is not possible to inhale, the first part is leakproof.

Place the upper unit on the housing of the disconnect assembly. To check the second part, it is necessary to disconnect hose KSh-26 from instrument KP-34, to close manually the opening in the sleeve elbow of the large diameter pipe, and make a shallow inhalation. If it is not possible to inhale, the second part is leakproof.

After this, connect hose KSh-26 to instrument KP-34 (at first, check: whether instrument valve KV-2MS is closed; whether the handle that turns off the tntake of air is in the "100% O_2" position, and set the pointer of indicator IK-18 at zero).

To test the third part, it is necessary to make a shallow inhalation. If it is not possible to inhale, the third part is leakproof. If inhalation is possible, the interior space of low pressure of instrument KP-34 is not sealed and the defective instrument must be replaced with a new one.

ATTENTION: 1. It should be remembered that leakage of the low pressure system depends largely on the condition of the rubber gaskets that are in each connection. Therefore, special attention should be paid to connectors (places of union), and defective gaskets should be replaced with new good ones before any harm can occur.

2. After testing the oxygen system for leakage in places where instruments are joined to pipes, on nuts and on nipples, and to apply [P 345] check marks with red paint on the instruments, to check the non-existence of damaged connections.

Check for leakage of the helmet exhaust valve on the special KU-6 control installation.

2.

2. OPERATIONAL CHECKOUT OF THE PILOT'S OXYGEN EQUIPMENT

Operational checkout of the pilot's oxygen equipment is performed both with and without excess pressure.

a) Checking with excess pressure:

Open valve KV-2MS

Put on helmet phone and previously adjusted helmet and pressure suit.

Connect regulator RSD-3M to the helmet, pressure suit, and parachute equipment KP-27M.

Close openings of pressure regulator (on housing of RSD-3M) and place suit oxygen supply lever located on the remote control panel, in the "Suit Turn-On" position.

By smooth counterclockwise rotation of the excess pressure pilot wheel on the remote control panel (middle lever), create in the helmet [P 346]
excess pressure equalling 1,800 mm of water column on an M-2000 pressure gauge (in this case, the setting markers of the indicator will move apart).

WARNING: When using mask KM-SOM instead of helmet GSh-4M, excess pressure in the mask must not exceed 1,000 mm of the water column.

When pressure in the helmet has risen to 1,800 mm of water column, if there is observed also a pressure rise in the suit and reduced pressure during inhalation and increased pressure during exhalation are observed on pressure gauge M-2000, operation of the equipment can be considered normal.

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ATTENTION: 1. Operation of the equipment should not be judged by the oxygen indicator, because at excess pressure, the indicator may or may not react to inhalation, which should be considered normal.

2. Under on-the-ground conditions, it is categorically prohibited to create excess pressure in the helmet without wearing a pressure suit because absence of the suit may cause lung damage.

b) Checking without excess pressure:

On the remote control panel, place the air intake lever in the "100% O_2" position and the suit oxygen supply lever in the neutral "N" position.

Close the manual excess pressure regulator on panel DU-2 as far as it can go.

Inhale and exhale two or three times. If the markers of the indicator diverge and converge, the KKO-V equipment is operating properly. After this, place the air intake lever into "Mixture" position. [P 347]

After checking the operation of the oxygen equipment, it is necessary to verify that the electric heating of the helmet glass operates normally, that is, that sweating of the glass is not observed, visibility is fully satisfactory, and the face does not feel excess heat.

Together with the radio equipment engineer, it is also necessary to check normal operation of communications (telephone, microphone) as indicated in the section "Radio Equipment."

When the aircraft is parked, valve KV-2MS must be closed.

2 7

3. CHECKOUT OF SWITCHOVER FROM THE AIRCRAFT OXYGEN SUPPLY TO THE PARACHUTE OXYGEN SUPPLY

The mechanism for switchover to the KP-27M parachute equipment provides for automatic (during ejection) and manual (if KP-34M equipment is out of operation) switchover of the equipments in operation. Therefore, checkout of supply switchover must be done for two cases.

a) Checkout of automatic switchover of KP-27M equipment

Checkout of automatic switchover of KP-27M equipment is carried out while pulling back the seat with the pilot in it, ORK-2 is being replaced, or the cockpit is being repaired. The pilot must be dressed in full flight uniform with all supply pipes connected.

Before pulling the seat, it is necessary: [P 348]

1. To raise the canopy:

WARNING: The firing mechanism must be disarmed.

2. Prepare the seat for pulling.

3. Check proper pipe connections to helmet and pressure suit of the disconnect assembly ORK-2.

4. Check the tightness of mounting of the upper unit of the assembly by means of a special rubber cord (shock absorber) and the suspension brackets and also connection of the aable to the ring of the emergency lever of the lower unit of the assembly.

5. Switch on oxygen supply and open valve KV-2MS.

6. Pull the seat with pilot (during this time,

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the pilot must take the same position as during ejection).

While pulling the seat:

a) Make certain that at the moment of separation of the assembly, the cable of the emergency lever of the unit does not touch units of the fuselage, seat, or any other equipment in the cabin.

b) When the lower unit of the assembly is being disconnected, there should be no strain on the aircraft hoses KSh-26, the hose of [P 349] the line of anti-g equipment, and the electrical and radio wiring on the track of the seat 30-40 mm after the disconnect lock has opened.

v) In switchover the supply of oxygen from the aircraft equipment KP-34 to the parachute equipment KP-27M, the pin of the cable for automatic switching of equipment KP-27M must be removed from the opening in the equipment, freeing it.

Continuing to breathe after disconnection from the KP-34 equipment, the pilot must make certain that oxygen flows normally from KP-27M equipment.

g) Make certain that the upper unit of the ORK-2 assembly is disconnected from the assembly housing for which the pilot must stand up or raise himself from the seat.

d) Make sure that the hoses are free of scratches.

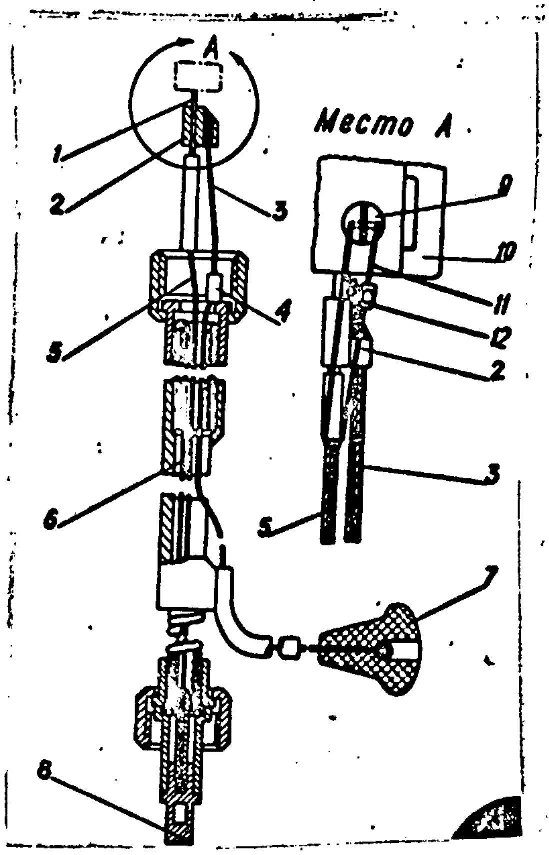
Pulling (raising) of the seat is performed at a distance of about 250 mm from the floor of the cockpit.

After checkout, put the seat in place and get the oxygen equipment in full ready condition.

[P 350]

Key to Figure 95. Mechanism for Switching ..... Oxygen Equipment KP- ...

1. Pin
2. Block
3. Manual switch-on cable
4. Support
5. Automatic switching cable
6. Limiting cable
7. Handle
8. Lug
9. Screw
10. Starter housing
11. Linen thread
12. Seal



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ATTENTION: When connecting the automatic switch-on cable of the KP-27M equipment to the starter of the equipment (by inserting the pin of the cable into the pin of the starter), do not forget to carry out safeting of the pin of the automatic switching cable with linen thread having a tensile strength of not over 12 kg. Perform saftying by attaching the thread to the cable, directly to the connecting bushing, and passing it through the opening in the screw. (Fig. 95).

b) Checking manual switchover of KP-27M equipment [P 351

After completely checking automatic switching of KP-27M equipment and putting all oxygen equipment in ready condition, perform manual switchover to the supply from KP-27M equipment.

The pilot carries out manual switchover of KP-27M equipment with the same set of equipment as in checking automatic switchover.

For checking manual switchover of KP-27M equipment, it is necessary to pull sharply on handle 12 (Fig. 89), drawing the manual switching cable of the KP-27M equipment up to the support, and making sure that the cable pin is removed from the opening, which will be evidenced by the flow of oxygen from the KP-27M parachute equipment into the helmet.

3

4. OPERATIONAL CHECKOUT OF ENGINE OXYGEN SUPPLY SYSTEM

(Preflight Preparation)

Operational checkout of the engine oxygen supply system is carried out on the ground with a running and hot engine as follows:

1. Open valve KV-2MS on the left side of the cabin, and ascertain on manometer MK-16 on the left panel whether there is pressure of 9-16 kg/sq cm in the low pressure system. Close valve KV-2MS (there must be no drop in pressure on the manometer for 3 minutes).

2. Check (on the ground) the engine starting system in flight according to the instructions for engine operation (headwind starting). [P 352]

3. After shutting off the engine, check the reading on the low pressure system manometer. Pressure must be zero kg/sq cm; if so, the system is fit for operation.

4. Open valve KV-2MS and ascertain whether the pressure on manometer MK-16 has again risen to 9-16 kg/sq cm in the low pressure system.

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5. CHECKOUT FOR LEAKAGE OF ENGINE OXYGEN SUPPLY SYSTEM

Checkout of the system for leakage up to valve "694400" is performed as follows:

1. Close valve KV-2MS (oxygen supply) and charge the cylinder with oxygen up to a pressure of 135-150 kg/sq cm.

Observe the reading on the high pressure manometer MK-12M. If the needle of the manometer remains immobile for 15 minutes, the high pressure system is leakproof. A drop in pressure is not permitted.

2. Check on manometer MK-16 the tightness of the low pressure oxygen system. For this, open valve KV-2MS and close it as soon as the pressure on the manometer reaches 9-16 kg/sq cm. Observe the manometer readings for 3-5 minutes. There must be no variation in the readings, for this indicates that the low pressure system is not tight.

In case the system is not tight, it is necessary to cover the junction points with soap suds in order to find the leak. [P 353]

A leak is eliminated by tightening nuts.

WARNING: It is prohibited to tighten joints while valve KV-2MS is open.

In the process of operation, it is necessary:

1. When installing a new or reconditioned engine in the aircraft, it is obligatory to clean of oil all pipes and valves of the engine oxygen supply system with clean ethyl alcohol and follow this with a blow-through with a netural gas (nitrogen).

[redacted]
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2. After replacing reducer 2130A in the engine oxygen supply system, check the pressure of oxygen supplying the engine; this must conform with the requirements set forth in the instructions for operating and servicing the engine.

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6. ORK-2 LINE DISCONNECT ASSEMBLY

The ORK-2 is designed for simultaneous, automatic disconnection of all lines leading from the aircraft equipment to the pilot and also assures the switching into operation of the KP-27M parachute oxygen equipment when the pilot is ejected.

The ORK-2 consists of the assembly frame (middle part of the assembly), upper unit, and lower unit (Fig. 87). The assembly frame is attached to the left handrail of the seat. [P 354]

At the moment of ejection, the assembly's cable which is fastened to the emergency lever of the lower unit, opens the assembly's mechanical lock. The assembly separates into three parts: the lower part with hoses remains on the aircraft, the middle part (frame) goes with the seat, and the upper part goes with the pilot.

Simultaneously, the hook of the lower unit engages the buckle of the cable of the mechanism for switching on equipment KP-27M and pulls it. Equipment KP-27M switches into operation. Check valves located on the upper unit of the assembly close and assure the preservation of excess pressure in the oxygen equipment system after ejection.

In the connections of the branches of the lower units, there are rubber gaskets that assure the airtight sealing of the assembly.

In the process of operation, it is necessary:

1. To keep grease and oil out of the inner cavities of the assembly's pipelines and also the outer surfaces of the connection sleeves.

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2. For the purpose of preventing the bending of shafts [redacted]age of electrical connections when closing the ORK-2, see to it that the cylindrical grooves of the upper and lower parts of the assembly are fully seated on the large-diameter shaft of the mount and do not come off in the process of closing. [P 355]

Basic technical data:

1. The force exerted on the emergency lever of the lock while opening the assembly should be not more than 30 kg or less than 5 kg.

2. Gas leakage:

In the line of anti-g equipment, at a pressure of 0.7 kg/sq cm, gas leakage should be not more than one liter/min.

In the line of the decompresssion chambers, at a pressure of 2 kg/sq cm, it should be not more than one liter/min.

In the line of the exhalation compensation valve, at a pressure of 0.25 kg/sq cm, it should be not more than 0.5 liter/min.

Resistance of the check valves of the closed assembly are not to exceed: inhalation oxygen line at consumption of 90 liters/min - 15 mm of the water column; remaining lines at consumption of 80 liters/min - 100 mm of the water column.

Resistance of the check valve of the inhalation line with the assembly disconnected and a flow of 25 liters/min - not more than 35 mm of the water column.

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Checkout for Leakage of the ORK-2 Disconnect Assembly

Checkout for leakage of the assembly with the aid of KU-6 equipment during the regular checkout of the seat (without removal of the assembly) in the following manner:

1. Remove the seat from the aircraft.

2. Disconnect the hoses of the lower unit from the aircraft equipment and connect the lower unit (with hoses) to the assembly frame. [P 356]

3. Connect the upper unit to the assembly frame.

4. Attach the proper connection sleeve of the assembly to the KU-6 equipment as shown in Fig. 96.

5. Set up length No 5 and scale No 5.

6. Close valves 10, 12, and 17 and reducer 8.

7. Connect a cylinder of oxygen to connection sleeve 7 with a pipeline and open the cylinder valve.

8. By means of reducer 8 create a pressure of 2-3 kg/sq cm, as determined on manometer 9.

9. Smoothly opening valve 10, create a pressure of 1,800 mm of the water column, as determined by the right scale of the monometric vacuum gauge.

10. Fix the readings of the rheometer.

11. To check for leakage of the oxygen inhalation connection sleeve, remove checkpoints No 10 and 33 and in place of them set up checkpoint No 9 and nozzle with nut from checkpoint No 113.

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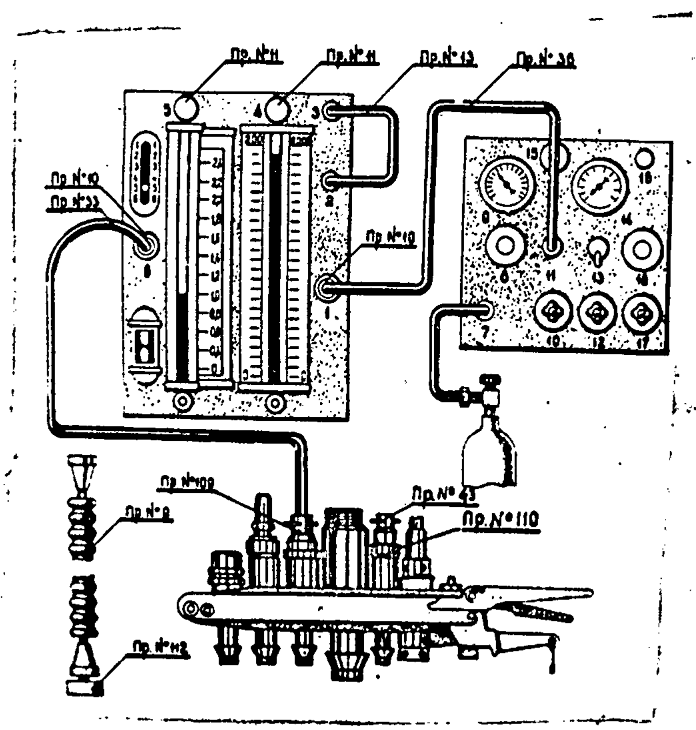
Key, Figure 96. Checkout for Leakage of ORK-2 Assembly on KU-6 Equipment [P 357]

Checkpoints, 10, 11, etc.



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The result of the checkout is considered positive, if the level of liquid in the rheometer rises not higher than the value of leakage established for the given connection sleeve.

WARNING: When there is leakage exceeding the permissible rate, [P 358] it is necessary to check the tightness of hose connections to the assembly and to replace the packing rings in the lower part of the assembly.

After checking the assembly for leakage, checkout of the check valves of the upper unit while the assembly is disconnected, in accordance with the description and instructions for assembly and operation of the ORK-2 disconnect assembly.

Operational Checkout of the ORK-2 Disconnect Assembly

Check the operation of the ORK-2, when performing routine maintanence every 12 months (without oxygen), combining the check with removal of the seat from the aircraft.

For the check, it is necessary:

1. To connect the upper unit to the disconnect assembly.

2. To place the parachute (with KP-27M equipment) in the seat).

3. To make sure that the cable is connected to the ring of the emergency lever of the lower unit of the assembly.

4. To make sure that the KV-2MS oxygen valve is closed.

When removing the seat from the aircraft, ascertain:

a) Disconnection of the lower unit of the assembly; after the [P 359] lock of the ORK-2 assembly has been tripped and the seat has moved 30-40 mm,

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there must be no pull on of the aircraft hoses and the hose of the counteroverloading equipment line of the suit.

b) Opening of the lock of the upper unit of the assembly.

v) Removal of the pin of the cable for automatic switching of equipment KP-27M from the hole in the pin of the equipment.

g) Separation of the upper block from the frame of the assembly.

7. CALCULATING OXYGEN SUPPLY [P 360

There are four spherical oxygen cylinders, each holding 2 liters, on the aircraft (two cylinders in each wing). Since oxygen consumption varies widely, depending on the elevation of the flight, atmospheric temperature, and individual characteristic of the pilot, an exact calculation of oxygen supply is difficult.

Average oxygen consumption for one person using KP-34 equipment is set at 6 liters/min, when the temperature is 15 degrees above zero Centigrade and pressure is 760 mm of mercury column.

The oxygen supply can be calculated in the following manner:

Four oxygen cylinders holding 2 liters each, charged to a pressure of 150 kg/sq cm.

To be determined: for how long a time will the pilot have oxygen?

Solution: Multiply the capacity of the cylinders by the pressure in the cylinders less a negligible supply equal to 30 kg/sq cm and divide the product by the average rate of oxygen consumption per minute. The quotient will be the approximate length of the flight while oxygen [P 361 is used, in minutes.

$$T = \frac{(4 \times 2)(150 - 60)}{6} = \frac{960}{6} = 160 \text{ min or } 2 \text{ hrs } 40 \text{ min}$$

More exact oxygen consumption is determined statistically on the basis of actual consumption rates in operation.

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8. POSSIBLE FAULTS OF THE UNIT KKO-3 AND THEIR ELIMINATION

Repair of KKO-3 unit involving dismantling and adjusting it in the field is not permitted.

Components of the unit needing such repair must be replaced with new (serviceable) ones, and the removed components sent to repair organs.

KP-34 Equipment

1. Leakage of high or low pressure housings. In this case replacement with new, serviceable equipment is necessary.

2. Leakage of valve of breathing equipment. In this [P 362] case, it is necessary to attach a hose to the equipment and to inhale and exhale deeply several times. If the leakage cannot be eliminated, replacement with new, serviceable equipment is necessary.

3. With the handle that controls delivery of oxygen to the suit in the "Suit Turn-On" position, there is no switchover from large to small delivery. In this case, replacement with new equipment is necessary.

KP-26 Reducer

1. Reducer leaks.

2. Reducer valve leaks.

This condition is accompanied by a rise in set (static) pressure above the permissible 14 kg/sq cm.

If either of the above defects occurs, replacement with a new, serviceable reducer is necessary.

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RSD-3M Pressure Ratio Regulator

1. Aneroid of helmet regulator is inaccurate. In this case, there takes place a rise in excess pressure in the helmet, even under on-the-ground conditions.

2. Aneroid of helmet pressure regulator leaks. In this case, when there is no excess pressure in the helmet and when the oxygen supply is turned into the suit, a rise of pressure takes place in the chambers of the suit under on-the-ground conditions.

In either case, the RSD-3M regulator must be replaced with a new one.

Helmet GSh-4M

1. The exhalation valve leaks.

When the exhalation valve leaks, it should be moistened (with a stream of water or several oral expectorations), after which it should be checked again for leakage.

Leakage of the valve may also be caused by dust, sand, or some other impurity lodging under the valve.

In this case, creating a vacuum under the valve, it is necessary to disconnect the rubber membranes and wipe them with cotton soaked in clean water, after which the valve should be blown with air containing no oil or oxygen.

After this, check the valve for leakage and resistance KU-6 equipment. [P 364]

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If the valve does not meet acceptable standards, it must be replaced with a new one.

2. The helmet and corrugated tube leak.

It is necessary to find where the leak is located and eliminate the defect, after which the helmet should be checked out for leakage on KU-6 equipment.

If it is not possible to eliminate the defect under field conditions, the helmet must be replaced with a new one.

3. Damage to the glass.

In all cases where damaged glass interferes with vision, and causes malfunctioning of electric heating and leakage, the helmet must be replaced with a new one.

VKK-3M Pressure Suit

1. The pressure suit leaks, the locks of the zipper are insecure.

In this case, replace the suit with a new, serviceable one.

KSh-26 Hose

1. The line hose is not tight. Replace the packing in the sleeve nuts. If the leakage has not been eliminated, replace the hose with a new, serviceable one.

IK-18 Indicator, M-2000 Pressure Gauge [P 365]

1. Broken glass, cracks in the housing, worn off luminous compound.

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2. Markers of the indicator do not react to inhaling and exhaling.

In either case, replacement with a new, serviceable indicator or manometer is necessary.

KV-2MS Valve

1. Valve housing is not tight.

2. Vent of the valve is not tight.

In either case, replace the valve with a new, serviceable one.

Aircraft Fittings Assembly with Check Valves

1. Check valves are not tight.

In this case, it is necessary to dismantle the assembly with reverse valves, then wipe the valve and its seat with a clean rag lightly moistened with clean gasoline (without admixture of oil); in doing this, make sure that all foreign matter (white or brown deposit) [P 366] has been removed from the valves and seats. Then, wash all parts of the dismantled unit in clean gasoline (without admixture of oil), blow over them with oxygen, and finally reassemble the unit.

If the unit is still not tight, it is necessary:

a) Either to replace the faulty valves and seats in the unit,

b) Or to replace the entire unit with a new, serviceable one.

KP-27M Equipment

1. The check valve of the filler sleeve is not tight.

2. The high pressure system is not tight.

3. The cable pin for the automatic switching of the equipment is defective.

4. There are defects in manometer MK-14M (readings are excessively inaccurate).

5. Low pressure equipment housing is not tight.

When any of these defects occur, the equipment must be replaced with new (serviceable) equipment.

9. SERVICING OXYGEN CYLINDERS [P 367]

When the aircraft has been standing for a long time, the oxygen system must be filled with oxygen to a pressure of at least 5 kg/sq cm and remain in this state with the KV-2MS valve closed.

In case the cylinder has to be removed from the aircraft, it is necessary to drain all of the oxygen from the system and then to remove the cylinder together with the T-sleeve connection.

WARNING: When draining oxygen from cylinders, it is necessary to disconnect the high pressure pipe lines from the high pressure sleeve connection of the KP-26 reducer. It is prohibited to drain oxygen through the reducer.

When storing or transporting a cylinder, it is necessary to attach a special flange to the T-sleeve connection from the outflow side, to fill the cylinder with oxygen to a pressure of 5 kg/sq cm, and then to close the filler valve.

The special flanges are supplied in a single unit.

NOTE: The cylinder T-sleeve connections have check valves.

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CHAPTER III [P 368]

PREPARATION OF OXYGEN EQUIPMENT FOR FLIGHT

1. PREFLIGHT PREPARATION

Oxygen Supply of the Pilot

Inspect and check:

1. The oxygen supply in the oxygen system on manometer IK-18. If necessary, replenish the system through the sleeve connection on the aircraft.

2. The oxygen pressure in the KP-27M parachute oxygen equipment. If at normal temperature the pressure in the equipment is under 150 kg/sq cm, it is necessary to replace it with new equipment with a normal pressure build-up. When checking, it is necessary to take into account the relationship between the equipment pressure and atmospheric temperature.

Check whether the equipment is properly packed in the container of the parachute, and check the saftying of the automatic switch-on cable pin.

3. Check the operation of radiocommunications and heating of the helmet sight glass by feel and by switching on the fourth terminal [P 369] connector and the LA-5 connector that brings the lines to the helmet and to the aircraft set through the ORK-2 disconnect assembly.

In case the glass sweats, it is authorized to heat it periodically by pressing the "Rapid Helmet Heating" button for 1-2 minutes at a time. The pilot performs this work.

4. The connections of all lines between pilot and aircraft. Make sure that the oxygen hose does not have any sharp twists from the parachute equipment to the RSD-3M regulator. The pilot and engineer perform this together.

5. The exterior condition of the ORK-2 disconnect assembly, the reliability of its locking, the reliability of the connection of the cable to the ring of the emergency lever of the lower unit of the disconnect assembly.

6. The operation of the oxygen equipment without excess pressure. When the check has been finished, valve KV-2MS should remain open.

7. The position of the handles controlling oxygen equipment on the remote control panel. The handle for continuous flow of oxygen into the suit must be in position "K"; the handle for switching off the air intake equipment in position "Mixture", and the pilot wheel of the manual regulator for creating excess pressure must be turned clockwise as far as possible.

8. The operation of the AN-5A pressure equipment (Fig. 85). For [P 370] this, the pilot must connect the sleeve connection of the counter-overloading equipment of the suit to the coupling of the hose (I), and, with a running engine (60-70 percent RND), press the button that checks the operation of the equipment. When he does this, air flows into the suit; when he removes his finger from the button, air is removed from the suit.

Press the button evenly, watching the inflation of the anti-g equipment of the suit.

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Attention: 1. When preparing the aircraft for a second takeoff, do only check No 1 if the pilot has not complained about the operation of the oxygen system.

2. Perform preflight preparation of the oxygen equipment after testing the engine and concluding of all preflight services.

Engine Oxygen Supply

Inspect and check:

9. The engine oxygen supply system on high pressure menometer MK-12M. If necessary, top off the system.

10. When testing the engine, check the operation of the engine oxygen supply system, as indicated in the section "Checking the Operation of the Engine Oxygen Supply System.

WARNING: 1. Before the pilot seats himself in the cabin, open the KV-2MS valve of the system. [P 371]

2. After the pilot has left the cabin, close the KV-2MS valve. When the aircraft is parked, this valve must be closed.

2. PRELIMINARY PREPARATION

Pilot's Oxygen Supply

Inspect and check:

1. The oxygen supply in the oxygen system on manometer IK-18. If necessary, top off the system through the aircraft filler sleeve connection.

2. The exterior condition of the oxygen hoses (they must show no kinks, cuts, or cracks) and helmet. Remove mositure on the rubber bushing, preliminarily wiping it with cotton soaked in alcohol. Check the security of oxygen hose connections.

3. As needed, wipe the sight glass of the helmet with VIAM-2 special paste. If the zipper sticks, it should be rubbed with paraffin or wax. The use of oil or grease is prohibited.

4. The reliability of installation of units on the aircraft and also the condition of pipe lines and remote control equipment.

[P 372]

5. The operation of the KP-84 remote control equipment, by manipulating the handles.

6. Leakage in the high and low pressure oxygen systems.

7. The efficiency of the oxygen system with and without excess pressure. Close oxygen valve KV-2MS, drain the oxygen from the low pressure system and fit flanges to the pressure ratio regulator. The pressure ratio regulator is hung on the pilot's seat.

8. In the KP-27M parachute oxygen equipment, check:

The amount of oxygen pressure in the equipment.

Flawlessness of the seal on the equipment.

Flawlessness of the saftying of the pin of the cable of the automatic switching mechanism.

9. Check the efficiency of the aircraft system for heating the sight glass of the helmet.

Engine Oxygen Supply

10. After the pilot has left the cabin, close valve KV-2MS of the system.

11. On manometer MK-12M, check the oxygen supply in the engine supply system. If necessary, top off the system. [P 373]

12. Condition of the pipelines and units of the system; the reliability of installation of units on the aircraft.

13. Leakage in the low pressure system on manometer MK-16.

14. Establish whether the "Engine Oxygen Supply" switch, located in the fuselage, is in the "Operation" position.

CHAPTER IV

[P 374]

SCHEDULED MAINTENANCE OF AIRCRAFT OXYGEN EQUIPMENT

Check the pilot's oxygen equipment on special control equipment of the KU-5 laboratory type and KU-6 portable type.

1. MAINTENANCE PERFORMED WHEN AIRCRAFT IS NOT IN SERVICE

Maintenance Performed	Every 7 ± 3 days	Every 30 ± 5 days	Every 3 months ± 10 days
1. Inspect the exterior condition and check the installation reliability of:			
Oxygen equipment		+	+
Remote control system		+	+
Oxygen reducer and valves		+	+
Oxygen indicator and excess pressure manometer		+	+
Oxygen manometers and filler sleeves		+	+
2. Check efficiency of oxygen equipment at excess pressure		+	+ [P 375]
3. Check for leakage of aircraft oxygen system		+	+
4. With the aircraft engineer, check for leakage of the engine oxygen supply system with valve KV-2MS closed and open		+	+

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2. MAINTENANCE PERFORMED WHEN AIRCRAFT IS IN SERVICE

Oxygen Equipment of the Pilot

Maintenance Performed	Every 50 $\pm$ 5 hours	Every 100 $\pm$ 10 hours
1. Remove from aircraft:		
KP-34 Oxygen Equipment		+
Pressure ratio regulator	+	+
Remote control equipment		+
2. Inspect the external condition of the KP-34 aircraft oxygen equipment and check /50-hour regulation maintenance is performed on the aircraft:		
Adjusting (static) pressure in oxygen equipment reducer	+	+
Excess pressure in the equipment held by the pressure closing valve and maximum excess pressure in the equipment created by the manual regulator [P 376]	+	+
Leakage of the high pressure housing and valve of the respiratory equipment		+
Leakage of the low pressure housing under vacuum and excess pressure conditions		+
Time excess pressure build up in helmet or mask	+	+
Leakage of vacuum valve		+

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Maintenance Performed	Every 50 ± 5 hours	Every 100 ± 10 hours
Resistance of vacuum valve		+
Resistance of inhalation equipment under on-the-ground conditions with the air inflow unit closed	+	+
Amount of oxygen supplied by the equipment with helmet sight shield open (or mask removed from the face)		+
Excess pressure of oxygen in the output of the equipment with no oxygen being consumed at an altitude of 10 km		+
Altitude of on and off switching of continuous supply of oxygen into the suit		+
Amount of continuous supply of oxygen		+
Pressure of open valve of breathing equipment		+
Percentage content of oxygen in gas mixture supplied by the equipment into helmet or mask		+
Excess pressure in the helmet held by the safety valve of the cover		+
Resistance of the check valve that opens into the cover		+
Resistance of the direct flow valve that opens in the direction of the exhalation valve		+
Pressure of the nozzle opening of the ejector		+
Maximum excess pressure in the equipment, created by the manual regulator under on-the-ground conditions, when the supplied pressure is 10 kg/sq cm		+

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Maintenance Performed	Every 50 ± 5 hours	Every 100 ± 10 hours
3. Inspect the exterior of the pressure ratio regulator and check:		
Pressure in the pressure system of the suit without excess pressure in the helmet	+	+
Pressure in the pressure system of the suit under on-the-ground conditions with excess pressure in the helmet from 0-1,800 mm of the water column		+
Excess pressure held by the regulator for heights in the helmet and in the pressure system of the suit	+	+
Leakage of the check valve of the lock		+
Leakage of the check valve of the regulator	+	+
Leakage of the check of the jettison valve	+	+
Leakage of the check of the bypass valve	+	+
Supply of oxygen through the apportioner under the exhalation valve from the parachute equipment	+	+
Resistance of the regulator valve		+ [P 378]
Supply of oxygen through the apportioner of the transfer valve and pressure of the opening of the regulator transfer valve		+
4. Inspect the exterior of the oxygen reducer and check:		
Adjusted (static) pressure		+
Pressure of the opening of the safety valve		+
Leakage		+

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Maintenance Performed	Every 50 ± 5 hours	Every 100 ± 10 hours
5. Inspect the exterior of the DU-2 remote control and check the securness of the cables to bushings fastenings (solders)		+
Check the magnitude of force for switching on continuous supply of oxygen into the suit. The force for switching on the supply of oxygen into the suit on the DU-2 Handle must not exceed 10 kg.		+
6. In regard to oxygen hoses, check:		
Exterior with seat removed	+	+
Leakage in lines leading to the pressure system of the G-suit and to the exhalation valve of the helmet together with the disconnect assembly (after seat has been set up)		+
7. Inspect the exterior of the oxygen indicator and check:		[P 379]
Leakage in the manometer housing		+
Instrument error of the manometer		+
Pressure when the indicator segments are fully opened		+
8. Inspect the exterior of the excess pressure manometer and check:		
Leakage in the manometer housing		+
Smoothness of pointer travel and instrument error		+

Maintenance Performed	Every 50 ± 5 hours	Every 100 ± 10 hours
9. Inspect the exterior and check secureness of installation of pipelines, aircraft fittings, oxygen clinders, and instruments	+	+
10. Inspect the disconnect assembly and check:		
The reliability of operation of the disconnect assembly and the switching into operation of the KP-27M parachute equipment (without oxygen) with seat removed from cabin	+	+
The condition of the rubber gaskets and cleanliness of internal areas	+	+
Condition of support rollers	+	+
COndition of valves, installation secureness and saftying of sleeve connections	+	+
Leakage in lines in a closed state	+	+
WARNING: Perform maintenance on the disconnect assembly simultaneously with seat removal. [P 380]		
11. Install on the aircraft:		
KP-34 oxygen equipment		+
RSD-3M	+	+
Remote control		+
12. Check correctness of assembly work, installation secureness of units, connection secureness of oxygen hoses, and saftying of nuts	+	+

Maintenance Performed	Every 50 ± 5 hours	Every 100 ± 10 hours
13. Blow system with oxygen and fill to normal pressure		+
14. On KKO-3 oxygen equipment, check:		
Smoothness of handle travel and regulation of remote control	+	+
Leakage in the low pressure system equipment together with the disconnect assembly both with and without excess pressure	+	+
Leakage in the high pressure system	+	+
AD-5A Pressure Unit		
1. Clean and inspect the AD-5A pressure unit filter. Use of soft hair brush to clean the unit with care		+
2. Together with an aircraft equipment specialist check the pressure produced by the AD-5A unit while the engine is running	+	+
Oxygen System Supplying the Engine [P 381]		
1. Inspect the exterior and check the secureness of connections of oxygen manometers, oxygen cylinders, and high-pressure lines. Also check the good working order of pipelines between the reducer and engine	+	+
2. Together with the aircraft engineer, check the tightness of the high pressure system with valve KV-2MS closed and the tightness of the low pressure system with the valve open	+	+

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Maintenance Performed	Every 50 ± 5 hours	Every 100 ± 10 hours
3. Together with an aircraft equipment specialist, inspect and check: [P 382]		
a) On the electropneumatic valve:		
Wear	+	+
Leakage		+
b) Reducer		
Adjusted pressure		+

TECHNICAL MAINTENANCE OF OXYGEN EQUIPMENT WITH AIRCRAFT GROUNDED

Every 10 ± 2 days

1. Perform the operations listed under Preflight Preparation of oxygen equipment.

Every 50 ± 5 days

1. Perform the operations listed under Preliminary Preparation of oxygen equipment.

Every 3 months ± 10 days

1. Perform the operations listed under Every 30 ± 5 days.

2. With engine running, check the counteroverloading equipment system.

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